



Lightning Aura Components Developer Guide

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CONTENTS

| | |
|---|----|
| Chapter 1: What Is the Lightning Component Framework? | 1 |
| What is Salesforce Lightning? | 2 |
| Why Use the Aura Components Programming Model? | 2 |
| Aura Components | 2 |
| Events | 3 |
| Open Source Aura Framework | 3 |
| Browser Support Considerations for Lightning Components | 4 |
| My Domain Is Required to Use Lightning Components in Your Salesforce Org | 6 |
| Using the Developer Console | 6 |
| Online Content | 7 |
| Chapter 2: Quick Start | 8 |
| Before You Begin | 9 |
| Trailhead: Explore Lightning Components Resources | 9 |
| Create a Component for Lightning Experience and the Salesforce Mobile App | 10 |
| Load the Contacts | 13 |
| Fire the Events | 17 |
| Chapter 3: Creating Components | 19 |
| Component Names | 21 |
| Create Aura Components in the Developer Console | 21 |
| Lightning Bundle Configurations Available in the Developer Console | 22 |
| Component Markup | 24 |
| Component Namespace | 24 |
| Using the Default Namespace in Organizations with No Namespace Set | 25 |
| Using Your Organization’s Namespace | 25 |
| Using a Namespace in or from a Managed Package | 26 |
| Creating a Namespace in Your Organization | 26 |
| Namespace Usage Examples and Reference | 26 |
| Component Bundles | 29 |
| Component IDs | 30 |
| HTML in Components | 31 |
| Supported HTML Tags | 32 |
| CSS in Components | 34 |
| Component Attributes | 35 |
| Supported aura:attribute Types | 36 |
| Basic Types | 37 |
| Function Type | 39 |
| Object Types | 39 |

Contents

| | |
|--|-----|
| Standard and Custom Object Types | 39 |
| Collection Types | 40 |
| Custom Apex Class Types | 41 |
| Framework-Specific Types | 42 |
| Using Expressions | 44 |
| Dynamic Output in Expressions | 46 |
| Conditional Expressions | 46 |
| Data Binding Between Components | 47 |
| Value Providers | 51 |
| Expression Evaluation | 58 |
| Expression Operators Reference | 59 |
| Expression Functions Reference | 62 |
| Component Composition | 65 |
| Component Body | 68 |
| Component Facets | 69 |
| Controlling Access | 70 |
| Application Access Control | 73 |
| Interface Access Control | 73 |
| Component Access Control | 73 |
| Attribute Access Control | 74 |
| Event Access Control | 74 |
| Using Object-Oriented Development | 74 |
| What is Inherited? | 75 |
| Inherited Component Attributes | 75 |
| Abstract Components | 77 |
| Interfaces | 77 |
| Inheritance Rules | 79 |
| Best Practices for Conditional Markup | 79 |
| Aura Component Versioning | 80 |
| Components with Minimum API Version Requirements | 81 |
| Validations for Aura Component Code | 82 |
| Validation When You Save Code Changes | 83 |
| Validation During Development Using the Salesforce CLI | 84 |
| Review and Resolve Validation Errors and Warnings | 88 |
| Aura Component Validation Rules | 89 |
| Salesforce Lightning CLI (Deprecated) | 95 |
| Using Labels | 95 |
| Using Custom Labels | 96 |
| Input Component Labels | 97 |
| Dynamically Populating Label Parameters | 97 |
| Getting Labels in JavaScript | 98 |
| Getting Labels in Apex | 99 |
| Setting Label Values via a Parent Attribute | 101 |
| Localization | 101 |

Contents

| | |
|--|------------|
| Providing Component Documentation | 103 |
| Working with Base Lightning Components | 105 |
| Base Lightning Components Considerations | 112 |
| Event Handling in Base Lightning Components | 114 |
| Lightning Design System Considerations | 116 |
| Working with UI Components | 137 |
| Event Handling in UI Components | 139 |
| Using the UI Components | 140 |
| Supporting Accessibility | 141 |
| Button Labels | 142 |
| Audio Messages | 142 |
| Forms, Fields, and Labels | 142 |
| Events | 143 |
| Menus | 143 |
| Chapter 4: Using Components | 145 |
| Aura Component Bundle Design Resources | 146 |
| Use Aura Components in Lightning Experience and the Salesforce Mobile App | 148 |
| Configure Components for Custom Tabs | 148 |
| Add Lightning Components as Custom Tabs in a Lightning Experience App | 149 |
| Add Lightning Components as Custom Tabs in the Salesforce App | 150 |
| Lightning Component Actions | 151 |
| Override Standard Actions with Aura Components | 158 |
| Navigate Across Your Apps with Page References | 162 |
| pageReference Types | 165 |
| Add Links to Lightning Pages from Your Custom Components | 171 |
| Get Your Aura Components Ready to Use on Lightning Pages | 172 |
| Configure Components for Lightning Pages and the Lightning App Builder | 172 |
| Configure Components for Lightning Experience Record Pages | 174 |
| Create Components for the Outlook and Gmail Integrations | 175 |
| Create Dynamic Picklists for Your Custom Components | 180 |
| Create a Custom Lightning Page Template Component | 181 |
| Lightning Page Template Component Best Practices | 184 |
| Make Your Lightning Page Components Width-Aware with lightning:flexipageRegionInfo | 184 |
| Tips and Considerations for Configuring Components for Lightning Pages and the Lightning App Builder | 186 |
| Use Aura Components in Community Builder | 187 |
| Configure Components for Communities | 187 |
| Create Custom Theme Layout Components for Communities | 188 |
| Create Custom Component for Guest User Flows | 191 |
| Create Custom Search and Profile Menu Components for Communities | 194 |
| Create Custom Content Layout Components for Communities | 195 |
| Use Aura Components with Flows | 197 |

Contents

| | |
|--|------------|
| Considerations for Configuring Components for Flows | 197 |
| Customize Flow Screens Using Aura Components | 201 |
| Create Flow Local Actions Using Aura Components | 211 |
| Embed a Flow in a Custom Aura Component | 215 |
| Display Flow Stages with an Aura Component | 221 |
| Add Components to Apps | 226 |
| Integrate Your Custom Apps into the Chatter Publisher | 226 |
| Using Background Utility Items | 231 |
| Use Lightning Components in Visualforce Pages | 232 |
| Add Aura Components to Any App with Lightning Out (Beta) | 234 |
| Lightning Out Requirements | 235 |
| Lightning Out Dependencies | 235 |
| Lightning Out Markup | 236 |
| Authentication from Lightning Out | 238 |
| Share Lightning Out Apps with Non-Authenticated Users | 239 |
| Lightning Out Considerations and Limitations | 240 |
| Lightning Container | 241 |
| Using a Third-Party Framework | 241 |
| Lightning Container Component Limits | 248 |
| The Lightning Realty App | 250 |
| lightning-container NPM Module Reference | 253 |
| Chapter 5: Communicating with Events | 259 |
| Actions and Events | 260 |
| Handling Events with Client-Side Controllers | 261 |
| Component Events | 263 |
| Component Event Propagation | 264 |
| Create Custom Component Events | 265 |
| Fire Component Events | 265 |
| Handling Component Events | 266 |
| Component Event Example | 272 |
| Application Events | 274 |
| Application Event Propagation | 275 |
| Create Custom Application Events | 276 |
| Fire Application Events | 277 |
| Handling Application Events | 278 |
| Application Event Example | 280 |
| Event Handling Lifecycle | 282 |
| Advanced Events Example | 284 |
| Firing Lightning Events from Non-Lightning Code | 288 |
| Events Best Practices | 289 |
| Events Anti-Patterns | 290 |
| Events Fired During the Rendering Lifecycle | 290 |
| Events Handled in the Salesforce Mobile App and Lightning Experience | 292 |

Contents

| | |
|---|------------|
| System Events | 294 |
| Chapter 6: Creating Apps | 295 |
| App Overview | 296 |
| Designing App UI | 296 |
| Creating App Templates | 297 |
| Using the AppCache | 297 |
| Distributing Applications and Components | 297 |
| Chapter 7: Styling Apps | 299 |
| Using the Salesforce Lightning Design System in Apps | 300 |
| Using External CSS | 300 |
| More Readable Styling Markup with the join Expression | 302 |
| Tips for CSS in Components | 303 |
| Vendor Prefixes | 303 |
| Styling with Design Tokens | 304 |
| Tokens Bundles | 304 |
| Create a Tokens Bundle | 305 |
| Defining and Using Tokens | 305 |
| Using Expressions in Tokens | 306 |
| Extending Tokens Bundles | 307 |
| Using Standard Design Tokens | 308 |
| Chapter 8: Developing Secure Code | 320 |
| What is Lightning Locker? | 321 |
| JavaScript Strict Mode Enforcement | 322 |
| DOM Access Containment | 322 |
| Secure Wrappers | 324 |
| eval() Function is Limited by Lightning Locker | 326 |
| MIME Types Permitted | 327 |
| Access to Supported JavaScript API Framework Methods Only | 328 |
| What Does Lightning Locker Affect? | 328 |
| Lightning Locker Tools | 328 |
| Disabling Lightning Locker for a Component | 334 |
| Don't Mix Component API Versions | 334 |
| Lightning Locker Disabled for Unsupported Browsers | 335 |
| Content Security Policy Overview | 335 |
| Stricter CSP Restrictions | 336 |
| Freeze JavaScript Prototypes | 337 |
| Chapter 9: Using JavaScript | 338 |
| Invoking Actions on Component Initialization | 340 |
| Sharing JavaScript Code in a Component Bundle | 340 |
| Sharing JavaScript Code Across Components | 343 |
| Using External JavaScript Libraries | 344 |

Contents

| | |
|---|------------|
| Dynamically Creating Components | 346 |
| Detecting Data Changes with Change Handlers | 349 |
| Finding Components by ID | 350 |
| Working with Attribute Values in JavaScript | 350 |
| Working with a Component Body in JavaScript | 352 |
| Working with Events in JavaScript | 353 |
| Modifying the DOM | 355 |
| Modifying DOM Elements Managed by the Aura Components Programming Model | 356 |
| Modifying DOM Elements Managed by External Libraries | 360 |
| Checking Component Validity | 360 |
| Modifying Components Outside the Framework Lifecycle | 362 |
| Validating Fields | 363 |
| Throwing and Handling Errors | 365 |
| Calling Component Methods | 367 |
| Return Result for Synchronous Code | 368 |
| Return Result for Asynchronous Code | 370 |
| Dynamically Adding Event Handlers To a Component | 372 |
| Dynamically Showing or Hiding Markup | 375 |
| Adding and Removing Styles | 375 |
| Which Button Was Pressed? | 377 |
| Formatting Dates in JavaScript | 378 |
| Using JavaScript Promises | 380 |
| Making API Calls from Components | 382 |
| Create CSP Trusted Sites to Access Third-Party APIs | 382 |
| Chapter 10: Using Apex | 384 |
| Creating Server-Side Logic with Controllers | 385 |
| Apex Server-Side Controller Overview | 386 |
| AuraEnabled Annotation | 386 |
| Creating an Apex Server-Side Controller | 387 |
| Calling a Server-Side Action | 388 |
| Passing Data to an Apex Controller | 391 |
| Returning Data from an Apex Server-Side Controller | 395 |
| Returning Errors from an Apex Server-Side Controller | 396 |
| Queueing of Server-Side Actions | 397 |
| Foreground and Background Actions | 398 |
| Storable Actions | 399 |
| Abortable Actions | 402 |
| Working with Salesforce Records | 403 |
| CRUD and Field-Level Security (FLS) | 406 |
| Saving Records | 407 |
| Deleting Records | 408 |
| Testing Your Apex Code | 410 |
| Making API Calls from Apex | 411 |

Contents

| | |
|--|------------|
| Creating Components in Apex | 412 |
| Chapter 11: Lightning Data Service | 413 |
| Loading a Record | 414 |
| Saving a Record | 415 |
| Creating a Record | 418 |
| Deleting a Record | 421 |
| Record Changes | 424 |
| Errors | 425 |
| Considerations | 426 |
| Lightning Data Service Example | 428 |
| SaveRecordResult | 432 |
| Chapter 12: Testing Components with Lightning Testing Service | 434 |
| How Lightning Testing Service Works | 435 |
| Install Lightning Testing Service | 436 |
| Get Started with Lightning Testing Service | 438 |
| Explore the Example Test Suites | 439 |
| Write Your Own Tests | 440 |
| Use Other Frameworks | 442 |
| Chapter 13: Debugging | 443 |
| Enable Debug Mode for Lightning Components | 444 |
| Disable Caching Setting During Development | 444 |
| Salesforce Lightning Inspector Chrome Extension | 445 |
| Install Salesforce Lightning Inspector | 445 |
| Salesforce Lightning Inspector | 445 |
| Log Messages | 459 |
| Chapter 14: Performance | 460 |
| Performance Settings | 461 |
| Enable Secure Browser Caching | 461 |
| Enable CDN to Load Applications Faster | 461 |
| Fixing Performance Warnings | 462 |
| <aura:if>—Clean Unrendered Body | 462 |
| <aura:iteration>—Multiple Items Set | 464 |
| Chapter 15: Reference | 467 |
| Component Library | 468 |
| Aura Reference Doc App | 468 |
| Differences Between Documentation Sites | 469 |
| System Tag Reference | 469 |
| aura:application | 470 |
| aura:dependency | 471 |
| aura:event | 472 |

Contents

| | |
|----------------------|------------|
| aura:interface | 473 |
| aura:method | 473 |
| aura:set | 475 |
| INDEX | 478 |

CHAPTER 1

What Is the Lightning Component Framework?

In this chapter ...

- [What is Salesforce Lightning?](#)
- [Why Use the Aura Components Programming Model?](#)
- [Aura Components](#)
- [Events](#)
- [Open Source Aura Framework](#)
- [Browser Support Considerations for Lightning Components](#)
- [My Domain Is Required to Use Lightning Components in Your Salesforce Org](#)
- [Using the Developer Console](#)
- [Online Content](#)

The Lightning Component framework is a UI framework for developing single page applications for mobile and desktop devices.

As of Spring '19 (API version 45.0), you can build Lightning components using two programming models: the Lightning Web Components model, and the original Aura Components model. Lightning web components are custom HTML elements built using HTML and modern JavaScript. Lightning web components and Aura components can coexist and interoperate on a page.

Configure Lightning web components and Aura components to work in Lightning App Builder and Community Builder. Admins and end users don't know which programming model was used to develop the components. To them, they're simply Lightning components.

This developer guide covers how to develop custom Aura components. The [Lightning Web Components Developer Guide](#) covers how to develop custom Lightning web components.

What is Salesforce Lightning?

Lightning includes the Lightning Component Framework and some exciting tools for developers. Lightning makes it easier to build responsive applications for any device.

Lightning includes these technologies:

- Lightning components accelerate development and app performance. Develop custom components that other developers and admins can use as reusable building blocks to customize Communities, the Salesforce mobile app, and Lightning Experience.
- Lightning App Builder empowers admins to build Lightning pages visually, without code, using off-the-shelf and custom-built Lightning components. Make your Lightning components available in the Lightning App Builder so administrators can build custom user interfaces without code.
- Community Builder empowers admins to build communities visually, without code, using Lightning templates and components. Make your Lightning components available in Community Builder so administrators can build community pages without code.

Using these technologies, you can seamlessly customize and easily deploy new apps to mobile devices running Salesforce. In fact, the Salesforce mobile app and Salesforce Lightning Experience are built with Lightning components.

This guide teaches you to create your own custom Aura components and apps. You also learn how to package applications and components and distribute them in the AppExchange.

To learn how to develop Lightning web components, see [Lightning Web Components Developer Guide](#).

Why Use the Aura Components Programming Model?

The benefits include an out-of-the-box set of components, event-driven architecture, and a framework optimized for performance.

Out-of-the-box Components

Comes with an out-of-the-box set of components to kick start building apps. You don't have to spend your time optimizing your apps for different devices as the components take care of that for you.

Rich Component Ecosystem

Create business-ready components and make them available in the Salesforce app, Lightning Experience, and Communities. Salesforce app users access your components via the navigation menu. Customize Lightning Experience or Communities using drag-and-drop components on a Lightning Page in the Lightning App Builder or using Community Builder. Additional components are available for your org in the AppExchange. Similarly, you can publish your components and share them with other users.

Fast Development

Empowers teams to work faster with out-of-the-box components that function seamlessly with desktop and mobile devices. Building an app with components facilitates parallel design, improving overall development efficiency.

Components are encapsulated and their internals stay private, while their public shape is visible to consumers of the component. This strong separation gives component authors freedom to change the internal implementation details and insulates component consumers from those changes.

Device-aware and Cross Browser Compatibility

Apps use responsive design and support the latest in browser technology such as HTML5, CSS3, and touch events.

Aura Components

Aura components are the self-contained and reusable units of an app. They represent a reusable section of the UI, and can range in granularity from a single line of text to an entire app.

The framework includes a set of prebuilt components. For example, components that come with the Lightning Design System styling are available in the `lightning` namespace. These components are also known as the base Lightning components. You can assemble and configure components to form new components in an app. Components are rendered to produce HTML DOM elements within the browser.

A component can contain other components, as well as HTML, CSS, JavaScript, or any other Web-enabled code. This enables you to build apps with sophisticated UIs.

The details of a component's implementation are encapsulated. This allows the consumer of a component to focus on building their app, while the component author can innovate and make changes without breaking consumers. You configure components by setting the named attributes that they expose in their definition. Components interact with their environment by listening to or publishing events.

SEE ALSO:

[Creating Components](#)

[Working with Base Lightning Components](#)

Events

Event-driven programming is used in many languages and frameworks, such as JavaScript and Java Swing. The idea is that you write handlers that respond to interface events as they occur.

A component registers that it may fire an event in its markup. Events are fired from JavaScript controller actions that are typically triggered by a user interacting with the user interface.

There are two types of events in the framework:

- **Component events** are handled by the component itself or a component that instantiates or contains the component.
- **Application events** are handled by all components that are listening to the event. These events are essentially a traditional publish-subscribe model.

You write the handlers in JavaScript controller actions.

SEE ALSO:

[Communicating with Events](#)

[Handling Events with Client-Side Controllers](#)

Open Source Aura Framework

The Aura Components programming model is built on the open source Aura framework. The Aura framework enables you to build apps completely independent of your data in Salesforce.

The Aura framework is available at github.com/forcedotcom/aura. Note that the open source Aura framework has features and components that are not currently available in the Aura Components programming model. We are working to surface more of these features and components for Salesforce developers.

The sample code in this guide uses out-of-the-box components from the Aura framework, such as `aura:iteration` and `ui:button`. The `aura` namespace contains components to simplify your app logic, and the `ui` namespace contains components for user interface elements like buttons and input fields. The `force` namespace contains components specific to Salesforce.

Browser Support Considerations for Lightning Components

Browser support varies across different Salesforce products and experiences. Use this browser support information as you build with Lightning components.

The following tables provide high-level minimum browser versions for various Salesforce features. There are additional requirements and recommended settings for all browsers, and a number of considerations that apply to specific browsers. See the browser compatibility details in Salesforce Help.

Lightning Experience and Lightning-Based Features

The following table describes minimum browser version requirements for using Lightning components within various features that are built with our next-generation user interface platform.

| | Microsoft® Internet Explorer® | Microsoft® Edge | Google Chrome™ | Mozilla® Firefox® | Apple® Safari® |
|--|--|------------------------|-----------------------|--------------------------|-----------------------|
| Lightning Experience | IE 11 (support for IE 9 and 10 ends on April 5, 2019) ¹ | Latest | Latest | Latest | 11.x+ |
| Salesforce Console in Lightning Experience | N/A | Latest | Latest | Latest | 11.x+ |
| Lightning Communities | IE 11 (support for IE 9 and 10 ends on April 5, 2019) | Latest | Latest | Latest | 11.x+ |
| Outlook integration (Client) | IE 11 (support for IE 9 and 10 ends on April 5, 2019) | N/A | N/A | N/A | N/A |
| Outlook integration (Web) | IE 11 (support for IE 9 and 10 ends on April 5, 2019) | Latest | Latest | Latest | 11.x+ |
| Standalone Lightning App (my.app) | IE 11 (support for IE 9 and 10 ends on April 5, 2019) | Latest | Latest | Latest | 11.x+ |
| Lightning Out | IE 11 (support for IE 9 and 10) | Latest | Latest | Latest | 11.x+ |

EDITIONS

Salesforce Classic available in: **All Editions**

EDITIONS

Lightning Experience is available in: **Group, Professional, Enterprise, Performance, Unlimited, and Developer Editions**

| | Microsoft® Internet Explorer® | Microsoft® Edge | Google Chrome™ | Mozilla® Firefox® | Apple® Safari® |
|--|--------------------------------------|------------------------|-----------------------|--------------------------|-----------------------|
| | ends on April 5, 2019) | | | | |

¹ Lightning Locker is disabled for IE11. We recommend using supported browsers other than IE11 for enhanced security.

! **Important:** Support for Internet Explorer 11 to access Lightning Experience is retiring beginning in Summer '16.

- You can continue to use IE11 to access Lightning Experience until December 16, 2017.
- If you opt in to [Extended Support for IE11](#), you can continue to use IE11 to access Lightning Experience until December 31, 2020.
- IE11 has [significant performance issues](#) in Lightning Experience.
- It is strongly recommended that you do not use Internet Explorer 11 with Community Builder.
- This change doesn't impact Salesforce Classic.

Lightning Components for Visualforce in Salesforce Classic

The following table describes minimum browser version requirements for using Lightning components within various features that are built with our classic user interface platform.

| | Microsoft® Internet Explorer® | Microsoft® Edge | Google Chrome™ | Mozilla® Firefox® | Apple® Safari® |
|--|---|------------------------|-----------------------|--------------------------|-----------------------|
| Salesforce Classic | IE 11 (support for IE 9 and 10 ends on April 5, 2019) | Latest | Latest | Latest | 11.x+ |
| Salesforce Console in Salesforce Classic | IE 11 (support for IE 9 and 10 ends on April 5, 2019) | Latest | Latest | Latest | N/A |
| Classic Communities | IE 11 (support for IE 9 and 10 ends on April 5, 2019) | Latest | Latest | Latest | 11.x+ |
| Salesforce Sites | IE 11 (support for IE 9 and 10 ends on April 5, 2019) | Latest | Latest | Latest | 11.x+ |

 **Note:** The term “latest” is defined by the browser vendors. Check with your browser vendor to determine the latest version available.

SEE ALSO:

[Salesforce Help: Supported Browsers](#)[Salesforce Help: Recommendations and Requirements for All Browsers](#)[Lightning Locker Disabled for Unsupported Browsers](#)[Content Security Policy Overview](#)

My Domain Is Required to Use Lightning Components in Your Salesforce Org

You must deploy My Domain in your org if you want to use Lightning components in Lightning tabs, Lightning pages, as standalone apps, as actions and action overrides, as custom Lightning page templates, or elsewhere in your org.

When My Domain isn’t deployed in your org, user interface controls related to Lightning components may be hidden or inactive. Lightning components added to pages, tabs, and so on, don’t run and may be omitted, or display a placeholder error message.

SEE ALSO:

[Salesforce Help: My Domain](#)

Using the Developer Console

The Developer Console provides tools for developing your Aura components and applications.



The Developer Console enables you to perform these functions.

- Use the menu bar (1) to create or open these Lightning resources.
 - Application
 - Component
 - Interface
 - Event
 - Tokens

- Use the workspace (2) to work on your Lightning resources.
- Use the sidebar (3) to create or open client-side resources that are part of a specific component bundle.
 - Controller
 - Helper
 - Style
 - Documentation
 - Renderer
 - Design
 - SVG

For more information on the Developer Console, see [The Developer Console User Interface](#).

SEE ALSO:

[Salesforce Help: Open the Developer Console](#)

[Create Aura Components in the Developer Console](#)

[Component Bundles](#)

Online Content

This guide is available online. To view the latest version, go to:

<https://developer.salesforce.com/docs/atlas.en-us.lightning.meta/lightning/>

Go beyond this guide with exciting Trailhead content. To explore more of what you can do with Lightning Components, go to:

Trailhead Module: Lightning Components Basics

Link: https://trailhead.salesforce.com/module/lex_dev_lc_basics

Learn with a series of hands-on challenges on how to use Lightning Components to build modern web apps.

Quick Start: Lightning Components

Link: <https://trailhead.salesforce.com/project/quickstart-lightning-components>

Create your first component that renders a list of Contacts from your org.

Project: Build an Account Geolocation App

Link: <https://trailhead.salesforce.com/project/account-geolocation-app>

Build an app that maps your Accounts using Lightning Components.

Project: Build a Restaurant-Locator Lightning Component

Link: <https://trailhead.salesforce.com/project/workshop-lightning-restaurant-locator>

Build a Lightning component with Yelp's Search API that displays a list of businesses near a certain location.

Project: Build a Lightning App with the Lightning Design System

Link: <https://trailhead.salesforce.com/project/slds-lightning-components-workshop>

Design a Lightning component that displays an Account list.

CHAPTER 2 Quick Start

In this chapter ...

- [Before You Begin](#)
- [Trailhead: Explore Lightning Components Resources](#)
- [Create a Component for Lightning Experience and the Salesforce Mobile App](#)

The quick start provides Trailhead resources for you to learn core Aura components concepts, and a short tutorial that builds an Aura component to manage selected contacts in the Salesforce app and Lightning Experience. You'll create all components from the Developer Console. The tutorial uses several events to create or edit contact records, and view related cases.

Before You Begin

To work with Lightning apps and components, follow these prerequisites.

1. [Create a Developer Edition organization](#)
2. [Define a Custom Salesforce Domain Name](#)

 **Note:** For this quick start tutorial, you don't need to create a Developer Edition organization or register a namespace prefix. But you want to do so if you're planning to offer managed packages. You can create Lightning components using the UI in **Enterprise, Performance, Unlimited, Developer** Editions, or a sandbox. If you don't plan to use a Developer Edition organization, you can go directly to [Define a Custom Salesforce Domain Name](#).

Create a Developer Edition Organization

You need an org to do this quick start tutorial, and we recommend you don't use your production org. You only need to create a Developer Edition org if you don't already have one.

1. In your browser, go to <https://developer.salesforce.com/signup?d=70130000000td6N>.
2. Fill in the fields about you and your company.
3. In the `Email` field, make sure to use a public address you can easily check from a Web browser.
4. Type a unique `Username`. Note that this field is also in the *form* of an email address, but it does not have to be the same as your email address, and in fact, it's usually better if they aren't the same. Your username is your login and your identity on `developer.salesforce.com`, so you're often better served by choosing a username such as `firstname.lastname@lastname.com`.
5. Read and then select the checkbox for the `Master Subscription Agreement` and then click **Submit Registration**.
6. In a moment you'll receive an email with a login link. Click the link and change your password.

Define a Custom Salesforce Domain Name

A custom domain name helps you enhance access security and better manage login and authentication for your organization. If your custom domain is `universalcontainers`, then your login URL would be <https://universalcontainers.lightning.force.com>. For more information, see [My Domain](#) in the Salesforce Help.

Trailhead: Explore Lightning Components Resources

Get up to speed with the fundamentals of Lightning components with Trailhead resources.

Whether you're a new Salesforce developer or a seasoned Visualforce developer, we recommend that you start with the following Trailhead resources.

[Lightning Components Basics](#)

Use Lightning components to build modern web apps with reusable UI components. You'll learn core Lightning components concepts and build a simple expense tracker app that can be run in a standalone app, Salesforce app, or Lightning Experience.

[Quick Start: Lightning Components](#)

Create your first component that renders a list of contacts from your org.

[Build an Account Geolocation App](#)

Build an app that maps your accounts using Lightning components.

Build a Lightning App with the Lightning Design System

Design a Lightning component that displays an account list.

Build a Restaurant-Locator Lightning Component

Build a Lightning component with Yelp's Search API that displays a list of businesses near a certain location.

Create a Component for Lightning Experience and the Salesforce Mobile App

Explore how to create a custom UI that loads contact data and interacts with Lightning Experience and the Salesforce app.

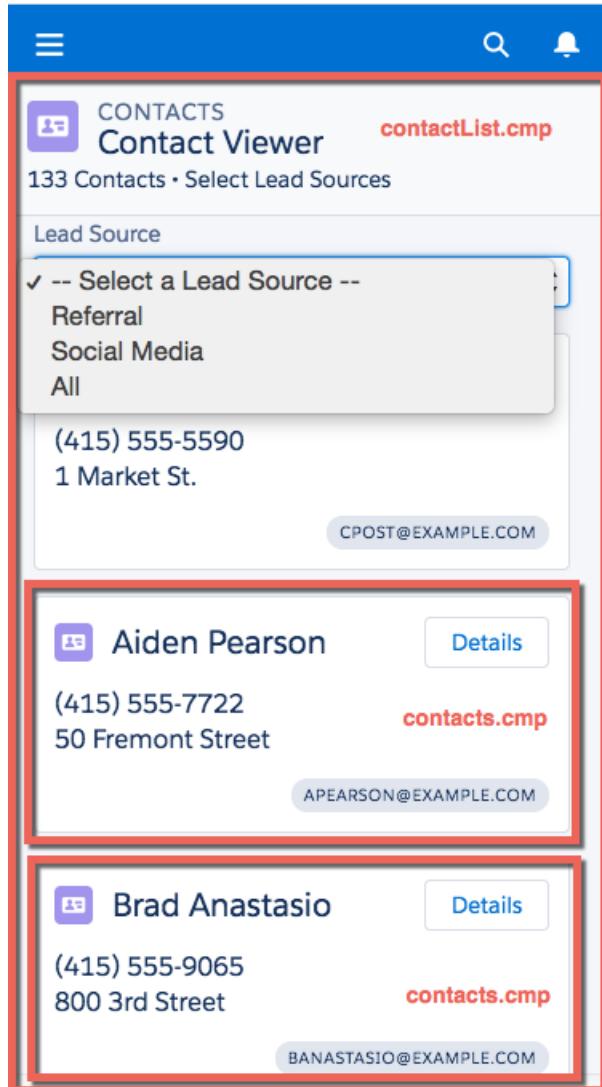
This tutorial walks you through creating a component that:

- Displays a toast message (1) using the `force:showToast` event when all contacts are loaded successfully.
- Updates the number of contacts (2) based on the selected lead source.
- Filters the contacts using the `lightning:select` component (3) when a lead source (referral or social media) is selected.
- Displays the contact data using the `lightning:card` component (4).
- Navigates to the record when the **Details** button (5) is clicked.

The screenshot shows the Salesforce Contact Viewer component. At the top, there's a navigation bar with Sales, Home, Chatter, Opportunities, Leads, Tasks, Files, Notes, Accounts, and Contacts. Below the navigation, the component title is "CONTACTS Contact Viewer" with "133 Contacts · Select Lead Sources". A red box labeled "2" highlights the "Select Lead Sources" dropdown. To the right, a success message box says "Success! Your contacts have been loaded successfully." with a red box labeled "1". Below the title, a "Lead Source" dropdown is shown with "3" in a red box. The main area displays three contact cards. Each card has a contact icon, the name, a "Details" button, and an email address. Red boxes labeled "4" and "5" highlight the contact cards for Chris Post and Aiden Pearson respectively.

| Contact | Phone | Address | Email |
|----------------|----------------|-------------------|------------------------|
| Chris Post | (415) 555-5590 | 1 Market St. | CPOST@EXAMPLE.COM |
| Aiden Pearson | (415) 555-7722 | 50 Fremont Street | APEARSON@EXAMPLE.COM |
| Brad Anastasio | (415) 555-9065 | 800 3rd Street | BANASTASIO@EXAMPLE.COM |

Here's how the component looks like in the Salesforce app. You're creating two components, `contactList` and `contacts`, where `contactList` is a container component that iterates over and displays `contacts` components. All contacts are displayed in `contactList`, but you can select different lead sources to view a subset of contacts associated with the lead source.



In the next few topics, you create the following resources.

| Resource | Description |
|---------------------------|---|
| Contacts Bundle | |
| contacts.cmp | The component that displays individual contacts |
| contactsController.js | The client-side controller action that navigates to a contact record using the <code>force:navigateToSObject</code> event |
| contactList Bundle | |
| contactList.cmp | The component that loads the list of contacts |
| contactListController.js | The client-side controller actions that call the helper resource to load contact data and handles the lead source selection |

| Resource | Description |
|------------------------|--|
| contactListHelper.js | The helper function that retrieves contact data, displays a toast message on successful loading of contact data, displays contact data based on lead source, and update the total number of contacts |
| Apex Controller | |
| ContactController.apxc | The Apex controller that queries all contact records and those records based on different lead sources |

Load the Contacts

Create an Apex controller and load your contacts. An Apex controller is the bridge that connects your components and your Salesforce data.

Your organization must have existing contact records for this tutorial.

1. Click **File > New > Apex Class**, and then enter `ContactController` in the **New Class** window. A new Apex class, `ContactController.apxc`, is created. Enter this code and then save.

```
public with sharing class ContactController {
    @AuraEnabled
    public static List<Contact> getContacts() {
        List<Contact> contacts =
            [SELECT Id, Name, MailingStreet, Phone, Email, LeadSource FROM Contact];

        //Add isAccessible() check
        return contacts;
    }
}
```

`ContactController` contains methods that return your contact data using SOQL statements. This Apex controller is wired up to your component in a later step. `getContacts()` returns all contacts with the selected fields.

2. Click **File > New > Lightning Component**, and then enter `contacts` for the `Name` field in the New Lightning Bundle popup window. This creates a component, `contacts.cmp`. Enter this code and then save.

```
<aura:component>
    <aura:attribute name="contact" type="Contact" />

    <lightning:card variant="Narrow" title="{!v.contact.Name}"
        iconName="standard:contact">
        <aura:set attribute="actions">
            <lightning:button name="details" label="Details" onclick="{!c.goToRecord}" />
        </aura:set>
        <aura:set attribute="footer">
            <lightning:badge label="{!v.contact.Email}" />
        </aura:set>
        <p class="slds-p-horizontal_small">
            {!v.contact.Phone}
        </p>
        <p class="slds-p-horizontal_small">
            {!v.contact.MailingStreet}
        </p>
    </lightning:card>
</aura:component>
```

```
</lightning:card>

</aura:component>
```

This component creates the template for your contact data using the `lightning:card` component, which simply creates a visual container around a group of information. This template gets rendered for every contact that you have, so you have multiple instances of a component in your view with different data. The `onclick` event handler on the `lightning:button` component calls the `goToRecord` client-side controller action when the button is clicked. Notice the expression `{!v.contact.Name}`? `v` represents the view, which is the set of component attributes, and `contact` is the attribute of type `Contact`. Using this dot notation, you can access the fields in the contact object, like `Name` and `Email`, after you wire up the Apex controller to the component in the next step.

- Click **File > New > Lightning Component**, and then enter `contactList` for the Name field in the New Lightning Bundle popup window, which creates the `contactList.cmp` component. Enter this code and then save. If you're using a namespace in your organization, replace `ContactController` with `myNamespace.ContactController`. You wire up the Apex controller to the component by using the `controller="ContactController"` syntax.

```
<aura:component implements="force:appHostable" controller="ContactController">
    <!-- Handle component initialization in a client-side controller -->
    <aura:handler name="init" value="{!this}" action=" {!c.doInit} "/>

    <!-- Dynamically load the list of contacts -->
    <aura:attribute name="contacts" type="Contact[]"/>
    <aura:attribute name="contactList" type="Contact[]"/>
    <aura:attribute name="totalContacts" type="Integer"/>

    <!-- Page header with a counter that displays total number of contacts -->
    <div class="slds-page-header slds-page-header_object-home">
        <lightning:layout>
            <lightning:layoutItem>
                <lightning:icon iconName="standard:contact" />
            </lightning:layoutItem>
            <lightning:layoutItem class="slds-m-left_small">
                <p class="slds-text-title_caps slds-line-height_reset">Contacts</p>
                <h1 class="slds-page-header__title slds-p-right_x-small">Contact
Viewer</h1>
            </lightning:layoutItem>
        </lightning:layout>
    </div>

    <lightning:layout>
        <lightning:layoutItem>
            <p class="slds-text-body_small">{!v.totalContacts} Contacts • View
Contacts Based on Lead Sources</p>
        </lightning:layoutItem>
    </lightning:layout>
</div>

    <!-- Body with dropdown menu and list of contacts -->
    <lightning:layout>
        <lightning:layoutItem padding="horizontal-medium" >
            <!-- Create a dropdown menu with options -->
            <lightning:select aura:id="select" label="Lead Source" name="source"
                onchange=" {!c.handleSelect}" class="slds-m-bottom_medium">
```

```

<option value="">-- Select a Lead Source --</option>
<option value="Referral" text="Referral"/>
<option value="Social Media" text="Social Media"/>
<option value="All" text="All"/>
</lightning:select>

<!-- Iterate over the list of contacts and display them -->
<aura:iteration var="contact" items="{!v.contacts}">
    <!-- If you're using a namespace, replace with myNamespace:contacts-->
    <c:contacts contact="{!contact}" />
</aura:iteration>
</lightning:layoutItem>
</lightning:layout>
</aura:component>

```

Let's dive into the code. We added the `init` handler to load the contact data during initialization. The handler calls the client-side controller code in the next step. We also added two attributes, `contacts` and `totalContacts`, which stores the list of contacts and a counter to display the total number of contacts respectively. Additionally, the `contactList` component is an attribute used to store the filtered list of contacts when an option is selected on the lead source dropdown menu. The `lightning:layout` components simply create grids to align your content in the view with Lightning Design System CSS classes.

The page header contains the `{ !v.totalContacts }` expression to dynamically display the number of contacts based on the lead source you select. For example, if you select **Referral** and there are 30 contacts whose `Lead Source` fields are set to **Referral**, then the expression evaluates to 30.

Next, we create a dropdown menu with the `lightning:select` component. When you select an option in the dropdown menu, the `onchange` event handler calls your client-side controller to update the view with a subset of the contacts. You create the client-side logic in the next few steps.

In case you're wondering, the `force:appHostable` interface enables your component to be surfaced in Lightning Experience and the Salesforce mobile app as tabs, which we are getting into later.

4. In the **contactList** sidebar, click **CONTROLLER** to create a resource named `contactListController.js`. Replace the placeholder code with the following code and then save.

```

({
  doInit : function(component, event, helper) {
    // Retrieve contacts during component initialization
    helper.loadContacts(component);
  },

  handleSelect : function(component, event, helper) {
    var contacts = component.get("v.contacts");
    var contactList = component.get("v.contactList");

    //Get the selected option: "Referral", "Social Media", or "All"
    var selected = event.getSource().get("v.value");

    var filter = [];
    var k = 0;
    for (var i=0; i<contactList.length; i++) {
      var c = contactList[i];
      if (selected != "All") {
        if(c.LeadSource == selected) {
          filter[k] = c;
        }
      }
    }
  }
});

```

```

        k++;
    }
}
else {
    filter = contactList;
}
}
//Set the filtered list of contacts based on the selected option
component.set("v.contacts", filter);
helper.updateTotal(component);
}
})
})

```

The client-side controller calls helper functions to do most of the heavy-lifting, which is a recommended pattern to promote code reuse. Helper functions also enable specialization of tasks, such as processing data and firing server-side actions, which is what we are covering next. Recall that the `onchange` event handler on the `lightning:select` component calls the `handleSelect` client-side controller action, which is triggered when you select an option in the dropdown menu. `handleSelect` checks the option value that's passed in using `event.getSource().get("v.value")`. It creates a filtered list of contacts by checking that the lead source field on each contact matches the selected lead source. Finally, update the view and the total number of contacts based on the selected lead source.

- In the `contactList` sidebar, click **HELPER** to create a resource named `contactListHelper.js`. Replace the placeholder code with the following code and then save.

```

({
loadContacts : function(cmp) {
    // Load all contact data
    var action = cmp.get("c.getContacts");
    action.setCallback(this, function(response) {
        var state = response.getState();
        if (state === "SUCCESS") {
            cmp.set("v.contacts", response.getReturnValue());
            cmp.set("v.contactList", response.getReturnValue());
            this.updateTotal(cmp);
        }

        // Display toast message to indicate load status
        var toastEvent = $A.get("e.force:showToast");
        if (state === 'SUCCESS'){
            toastEvent.setParams({
                "title": "Success!",
                "message": " Your contacts have been loaded successfully."
            });
        }
        else {
            toastEvent.setParams({
                "title": "Error!",
                "message": " Something has gone wrong."
            });
        }
        toastEvent.fire();
    });
    $A.enqueueAction(action);
},

```

```

updateTotal: function(cmp) {
    var contacts = cmp.get("v.contacts");
    cmp.set("v.totalContacts", contacts.length);
}
)

```

During initialization, the `contactList` component loads the contact data by:

- Calling the Apex controller method `getContacts`, which returns the contact data via a SOQL statement
- Setting the return value via `cmp.set("v.contacts", response.getReturnValue())` in the action callback, which updates the view with the contact data
- Updating the total number of contacts in the view, which is evaluated in `updateTotal`

You must be wondering how your component works in Lightning Experience and the Salesforce app. Let's find out next!

6. Make the `contactList` component available via a custom tab in Lightning Experience and the Salesforce app.

- [Add Lightning Components as Custom Tabs in a Lightning Experience App](#)
- [Add Lightning Components as Custom Tabs in the Salesforce App](#)

For this tutorial, we recommend that you add the component as a custom tab in Lightning Experience.

When your component is loaded in Lightning Experience or the Salesforce app, a toast message indicates that your contacts are loaded successfully. Select a lead source from the dropdown menu and watch your contact list and the number of contacts update in the view.

Next, wire up an event that navigates to a contact record when you click a button in the contact list.

Fire the Events

Fire the events in your client-side controller or helper functions. The `force` events are handled by Lightning Experience and the Salesforce mobile app, but let's view and test the components in Lightning Experience to simplify things.

This demo builds on the contacts component you created in [Load the Contacts](#) on page 13.

1. In the `contacts` sidebar, click **CONTROLLER** to create a resource named `contactsController.js`. Replace the placeholder code with the following code and then save.

```

({
    goToRecord : function(component, event, helper) {
        // Fire the event to navigate to the contact record
        var sObjectEvent = $A.get("e.force:navigateToSObject");
        sObjectEvent.setParams({
            "recordId": component.get("v.contact.Id")
        })
        sObjectEvent.fire();
    }
})

```

The `onclick` event handler in the following button component triggers the `goToRecord` client-side controller when the button is clicked.

```
<lightning:button name="details" label="Details" onclick="{!c.goToRecord}" />
```

You set the parameters to pass into the events using the `event.setParams()` syntax. In this case, you're passing in the Id of the contact record to navigate to. There are other events besides `force:navigateToSObject` that simplify navigation within

Lightning Experience and the Salesforce app. For more information, see [Events Handled in the Salesforce Mobile App and Lightning Experience](#).

2. To test the event, refresh your custom tab in Lightning Experience, and click the **Details** button.

The `force:navigateToSObject` is fired, which updates the view to display the contact record page.

We stepped through creating a component that loads contact data using a combination of client-side controllers and Apex controller methods to create a custom UI with your Salesforce data. The possibilities of what you can do with Aura components are endless. While we showed you how to surface a component via a tab in Lightning Experience and the Salesforce app, you can take this tutorial further by surfacing the component on record pages via the Lightning App Builder and even Communities. To explore the possibilities, blaze the trail with the resources available at [Trailhead: Explore Lightning Components Resources](#).

CHAPTER 3 Creating Components

In this chapter ...

- Component Names
- Create Aura Components in the Developer Console
- Component Markup
- Component Namespace
- Component Bundles
- Component IDs
- HTML in Components
- CSS in Components
- Component Attributes
- Using Expressions
- Component Composition
- Component Body
- Component Facets
- Controlling Access
- Using Object-Oriented Development
- Best Practices for Conditional Markup
- Aura Component Versioning
- Components with Minimum API Version Requirements
- Validations for Aura Component Code
- Using Labels
- Localization

Components are the functional units of the Lightning Component framework.

A component encapsulates a modular and potentially reusable section of UI, and can range in granularity from a single line of text to an entire application.

Creating Components

- Providing Component Documentation
- Working with Base Lightning Components
- Working with UI Components
- Supporting Accessibility

Component Names

A component name must follow the naming rules for Lightning components.

A component name must follow these naming rules:

- Must begin with a letter
- Must contain only alphanumeric or underscore characters
- Must be unique in the namespace
- Can't include whitespace
- Can't end with an underscore
- Can't contain two consecutive underscores

SEE ALSO:

[Create Aura Components in the Developer Console](#)

[Component Markup](#)

Create Aura Components in the Developer Console

The Developer Console is a convenient, built-in tool you can use to create new and edit existing Aura components and other bundles.

1. Open the Developer Console.

Select **Developer Console** from the *Your Name* or the quick access menu ().

2. Open the New Lightning Bundle panel for an Aura component.

Select **File > New > Lightning Component**.

3. Name the component.

For example, enter `helloWorld` in the Name field.

4. Optional: Describe the component.

Use the Description field to add details about the component.

5. Optional: Add component configurations to the new component.

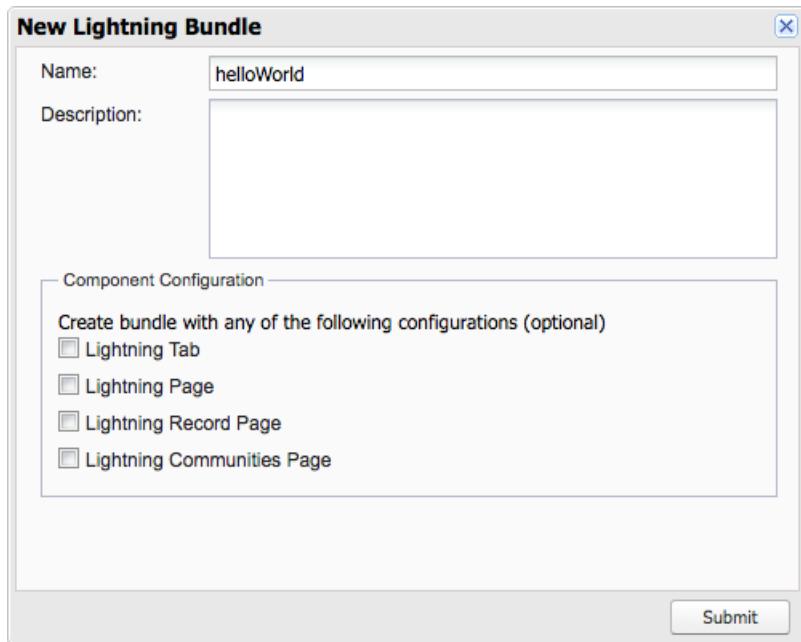
You can select as many options in the Component Configuration section as you wish, or select no configuration at all.

6. Click **Submit** to create the component.

Or, to cancel creating the component, click the panel's close box in the top right corner.



Example:



IN THIS SECTION:

[Lightning Bundle Configurations Available in the Developer Console](#)

Configurations make it easier to create a component or application for a specific purpose, like a Lightning Page or Lightning Communities Page, or a quick action or navigation item in Lightning Experience or Salesforce mobile app. The New Lightning Bundle panel in the Developer Console offers a choice of component configurations when you create an Aura component or application bundle.

SEE ALSO:

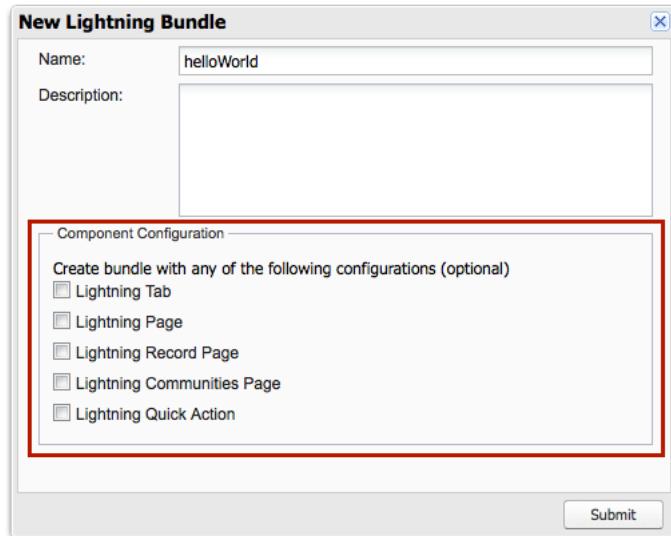
[Using the Developer Console](#)

[Lightning Bundle Configurations Available in the Developer Console](#)

Lightning Bundle Configurations Available in the Developer Console

Configurations make it easier to create a component or application for a specific purpose, like a Lightning Page or Lightning Communities Page, or a quick action or navigation item in Lightning Experience or Salesforce mobile app. The New Lightning Bundle panel in the Developer Console offers a choice of component configurations when you create an Aura component or application bundle.

Configurations add the interfaces required to support using the component in the desired context. For example, when you choose the **Lightning Tab** configuration, your new component includes `implements="force:appHostable"` in the `<aura:component>` tag.



Using configurations is optional. You can use them in any combination, including all or none.

The following configurations are available in the New Lightning Bundle panel.

| Configuration | Markup | Description |
|-------------------------------------|--|--|
| Aura component bundle | | |
| Lightning Tab | <code>implements="force:appHostable"</code> | Creates a component for use as a navigation element in Lightning Experience or Salesforce mobile apps. |
| Lightning Page | <code>implements="flexipage:availableForAllPageTypes"</code> and <code>access="global"</code> | Creates a component for use in Lightning pages or the Lightning App Builder. |
| Lightning Record Page | <code>implements="flexipage:availableForRecordHome,</code> <code>force:hasRecordId"</code> and <code>access="global"</code> | Creates a component for use on a record home page in Lightning Experience. |
| Lightning Communities Page | <code>implements="forceCommunity:availableForAllPageTypes"</code> and <code>access="global"</code> | Creates a component that's available for drag and drop in the Community Builder. |
| Lightning Quick Action | <code>implements="force:lightningQuickAction"</code> | Creates a component that can be used with a Lightning quick action. |
| Lightning application bundle | | |
| Lightning Out Dependency App | <code>extends="ltng:outApp"</code> | Creates an empty Lightning Out dependency app. |



Note: For details of the markup added by each configuration, see the respective documentation for those features.

SEE ALSO:

- [Create Aura Components in the Developer Console](#)
- [Configure Components for Custom Tabs](#)
- [Configure Components for Custom Actions](#)
- [Configure Components for Lightning Pages and the Lightning App Builder](#)
- [Configure Components for Lightning Experience Record Pages](#)
- [Configure Components for Communities](#)

Component Markup

Component resources contain markup and have a `.cmp` suffix. The markup can contain text or references to other components, and also declares metadata about the component.

Let's start with a simple "Hello, world!" example in a `helloWorld.cmp` component.

```
<aura:component>
    Hello, world!
</aura:component>
```

This is about as simple as a component can get. The "Hello, world!" text is wrapped in the `<aura:component>` tags, which appear at the beginning and end of every component definition.

Components can contain most HTML tags so you can use markup, such as `<div>` and ``. HTML5 tags are also supported.

```
<aura:component>
    <div class="container">
        <!--Other HTML tags or components here-->
    </div>
</aura:component>
```



Note: Case sensitivity should be respected as your markup interacts with JavaScript, CSS, and Apex.

SEE ALSO:

- [Using the Developer Console](#)
- [Component Names](#)
- [Component Access Control](#)

Component Namespace

Every component is part of a namespace, which is used to group related components together. If your organization has a namespace prefix set, use that namespace to access your components. Otherwise, use the default namespace to access your components.

Another component or application can reference a component by adding `<myNamespace:myComponent>` in its markup. For example, the `helloWorld` component is in the `docsample` namespace. Another component can reference it by adding `<docsample:helloWorld />` in its markup.

Lightning components that Salesforce provides are grouped into several namespaces, such as `aura`, `ui`, and `force`. Components from third-party managed packages have namespaces from the providing organizations.

In your organization, you can choose to set a namespace prefix. If you do, that namespace is used for all of your Lightning components. A namespace prefix is required if you plan to offer managed packages on the AppExchange.

If you haven't set a namespace prefix for your organization, use the default namespace `c` when referencing components that you've created.

Namespaces in Code Samples

The code samples throughout this guide use the default `c` namespace. Replace `c` with your namespace if you've set a namespace prefix.

Using the Default Namespace in Organizations with No Namespace Set

If your organization hasn't set a namespace prefix, use the default namespace `c` when referencing Lightning components that you've created.

The following items must use the `c` namespace when your organization doesn't have a namespace prefix set.

- References to components that you've created
- References to events that you've defined

The following items use an implicit namespace for your organization and don't require you to specify a namespace.

- References to custom objects
- References to custom fields on standard and custom objects
- References to Apex controllers

See [Namespace Usage Examples and Reference](#) on page 26 for examples of all of the preceding items.

Using Your Organization's Namespace

If your organization has set a namespace prefix, use that namespace to reference Lightning components, events, custom objects and fields, and other items in your Lightning markup.

The following items use your organization's namespace when your organization has a namespace prefix set.

- References to components that you've created
- References to events that you've defined
- References to custom objects
- References to custom fields on standard and custom objects
- References to Apex controllers
- References to static resources

 **Note:** Support for the `c` namespace in organizations that have set a namespace prefix is incomplete. The following items can use the `c` namespace if you prefer to use the shortcut, but it's not currently a recommended practice.

- References to components that you've created when used in Lightning markup, but not in expressions or JavaScript
- References to events that you've defined when used in Lightning markup, but not in expressions or JavaScript
- References to custom objects when used in component and event `type` and `default` system attributes, but not in expressions or JavaScript

See [Namespace Usage Examples and Reference](#) on page 26 for examples of the preceding items.

Using a Namespace in or from a Managed Package

Always use the complete namespace when referencing items from a managed package, or when creating code that you intend to distribute in your own managed packages.

Creating a Namespace in Your Organization

Create a namespace for your organization by registering a namespace prefix.

If you're not creating managed packages for distribution then registering a namespace prefix isn't required, but it's a best practice for all but the smallest organizations.

Your namespace prefix must:

- Begin with a letter
- Contain one to 15 alphanumeric characters
- Not contain two consecutive underscores

For example, `myNp123` and `my_np` are valid namespaces, but `123Company` and `my__np` aren't.

To register a namespace prefix:

1. From Setup, enter **Packages** in the Quick Find box. Under Create, select **Packages**.

 **Note:** This item is only available in Salesforce Classic.

2. In the Developer Settings panel, click **Edit**.

 **Note:** This button doesn't appear if you've already configured your developer settings.

3. Review the selections that are required for configuring developer settings, and then click **Continue**.
4. Enter the namespace prefix you want to register.
5. Click **Check Availability** to determine if the namespace prefix is already in use.
6. If the namespace prefix that you entered isn't available, repeat the previous two steps.
7. Click **Review My Selections**.
8. Click **Save**.

Namespace Usage Examples and Reference

This topic provides examples of referencing components, objects, fields, and so on in Aura components code.

Examples are provided for the following.

- Components, events, and interfaces in your organization
- Custom objects in your organization
- Custom fields on standard and custom objects in your organization
- Server-side Apex controllers in your organization
- Dynamic creation of components in JavaScript
- Static resources in your organization

Organizations with No Namespace Prefix Set

The following illustrates references to elements in your organization when your organization doesn't have a namespace prefix set. References use the default namespace, `c`, where necessary.

| Referenced Item | Example |
|--|---|
| Component used in markup | <code><c:myComponent /></code> |
| Component used in a system attribute | <code><aura:component extends="c:myComponent"></code> <code><aura:component implements="c:myInterface"></code> |
| Apex controller | <code><aura:component controller="ExpenseController"></code> |
| Custom object in attribute data type | <code><aura:attribute name="expense" type="Expense__c" /></code> |
| Custom object or custom field in attribute defaults | <code><aura:attribute name="newExpense" type="Expense__c"</code> <code>default="{ 'sobjectType': 'Expense__c',</code> <code> 'Name': '',</code> <code> 'Amount__c': 0,</code> <code> ...</code> <code>} " /></code> |
| Custom field in an expression | <code><ui:inputNumber value="{!v.newExpense.Amount__c}" label="..." /></code> |
| Custom field in a JavaScript function | <code>updateTotal: function(component) {</code> <code> ...</code> <code> for(var i = 0 ; i < expenses.length ; i++){</code> <code> var exp = expenses[i];</code> <code> total += exp.Amount__c;</code> <code> }</code> <code> ...</code> <code>}</code> |
| Component created dynamically in a JavaScript function | <code>var myCmp = \$A.createComponent("c:myComponent", {},</code> <code> function(myCmp) { }</code> <code>);</code> |
| Interface comparison in a JavaScript function | <code>aCmp.isInstanceOf("c:myInterface")</code> |
| Event registration | <code><aura:registerEvent type="c:updateExpenseItem" name="..." /></code> |
| Event handler | <code><aura:handler event="c:updateExpenseItem" action="..." /></code> |
| Explicit dependency | <code><aura:dependency resource="markup://c:myComponent" /></code> |
| Application event in a JavaScript function | <code>var updateEvent = \$A.get("e.c:updateExpenseItem");</code> |

| Referenced Item | Example |
|------------------|---|
| Static resources | <ltng:require scripts="{\$Resource.resourceName}" styles="{\$Resource.resourceName}" /> |

Organizations with a Namespace Prefix

The following illustrates references to elements in your organization when your organization has set a namespace prefix. References use an example namespace `yournamespace`.

| Referenced Item | Example |
|--|---|
| Component used in markup | < yournamespace:myComponent /> |
| Component used in a system attribute | <aura:component extends=" yournamespace:myComponent "> <aura:component implements=" yournamespace:myInterface "> |
| Apex controller | <aura:component controller=" yournamespace.ExpenseController "> |
| Custom object in attribute data type | <aura:attribute name="expenses" type=" yournamespace__Expense__c[] " /> |
| Custom object or custom field in attribute defaults | <aura:attribute name="newExpense" type="yournamespace__Expense__c" default="{ 'sobjectType': 'yournamespace__Expense__c', 'Name': '', 'yournamespace__Amount__c': 0, ... }" /> |
| Custom field in an expression | <ui:inputNumber value="!v.newExpense.yournamespace__Amount__c" label="..." /> |
| Custom field in a JavaScript function | updateTotal: function (component) { ... for (var i = 0 ; i < expenses.length ; i++){ var exp = expenses[i]; total += exp.yournamespace__Amount__c; } ... } |
| Component created dynamically in a JavaScript function | var myCmp = \$A.createComponent("yournamespace:myComponent", {}, function (myCmp) { }); |
| Interface comparison in a JavaScript function | aCmp.isInstanceOf("yournamespace:myInterface") |

| Referenced Item | Example |
|--|--|
| Event registration | <code><aura:registerEvent type="yournamespace:updateExpenseItem" name=... /></code> |
| Event handler | <code><aura:handler event="yournamespace:updateExpenseItem" action=... /></code> |
| Explicit dependency | <code><aura:dependency resource="markup://yournamespace:myComponent" /></code> |
| Application event in a JavaScript function | <code>var updateEvent = \$A.get("e.yournamespace:updateExpenseItem");</code> |
| Static resources | <code><ltng:require scripts="{!\$Resource.yournamespace__resourceName}" styles="{!\$Resource.yournamespace__resourceName}" /></code> |

Component Bundles

A component bundle contains a component or an app and all its related resources.

| Resource | Resource Name | Usage | See Also |
|--------------------------|--------------------------|--|--|
| Component or Application | sample.cmp or sample.app | The only required resource in a bundle. Contains markup for the component or app. Each bundle contains only one component or app resource. | Creating Components on page 19 aura:application on page 470 |
| CSS Styles | sample.css | Contains styles for the component. | CSS in Components on page 34 |
| Controller | sampleController.js | Contains client-side controller methods to handle events in the component. | Handling Events with Client-Side Controllers on page 261 |
| Design | sample.design | File required for components used in Lightning App Builder, Lightning pages, Community Builder, or Flow Builder. | Aura Component Bundle Design Resources |
| Documentation | sample.auradoc | A description, sample code, and one or multiple references to example components | Providing Component Documentation on page 103 |
| Renderer | sampleRenderer.js | Client-side renderer to override default rendering for a component. | Create a Custom Renderer on page 357 |

| Resource | Resource Name | Usage | See Also |
|----------|-----------------|---|--|
| Helper | sampleHelper.js | JavaScript functions that can be called from any JavaScript code in a component's bundle | Sharing JavaScript Code in a Component Bundle on page 340 |
| SVG File | sample.svg | Custom icon resource for components used in the Lightning App Builder or Community Builder. | Configure Components for Lightning Pages and the Lightning App Builder on page 172 |

All resources in the component bundle follow the naming convention and are auto-wired. For example, a controller `<componentName>Controller.js` is auto-wired to its component, which means that you can use the controller within the scope of that component.

Component IDs

A component has two types of IDs: a local ID and a global ID. You can retrieve a component using its local ID in your JavaScript code. A global ID can be useful to differentiate between multiple instances of a component or for debugging purposes.

Local IDs

A local ID is an ID that is only scoped to the component. A local ID is often unique but it's not required to be unique.

Create a local ID by using the `aura:id` attribute. For example:

```
<lightning:button aura:id="button1" label="button1"/>
```

 **Note:** `aura:id` doesn't support expressions. You can only assign literal string values to `aura:id`.

Find the button component by calling `cmp.find("button1")` in your client-side controller, where `cmp` is a reference to the component containing the button.

`find()` returns different types depending on the result.

- If the local ID is unique, `find()` returns the component.
- If there are multiple components with the same local ID, `find()` returns an array of the components.
- If there is no matching local ID, `find()` returns `undefined`.

To find the local ID for a component in JavaScript, use `cmp.getLocalId()`.

Global IDs

Every component has a unique `globalId`, which is the generated runtime-unique ID of the component instance. A global ID (1) is not guaranteed to be the same beyond the lifetime of a component, so it should never be relied on. A global ID can be useful to differentiate between multiple instances of a component or for debugging purposes.

```

▼<div class="slds-select_container" data-aura-
rendered-by="1624:0">
  ::before
  ▼<select class="slds-select" id="1611:0" data-aura-
rendered-by="1625:0" name="select" required aria-
describedby="1611:0-desc">
  <option data-aura-rendered-by="1613:
  0">Red</option>
  <option data-aura-rendered-by="1614:
  0">Green</option>
  <option data-aura-rendered-by="1615:
  0">Blue</option>
</select>
  ::after
</div>

```

To create a unique ID for an HTML element, you can use the `globalId` as a prefix or suffix for your element. For example:

```
<div id="{!globalId + '_footer'}"></div>
```

In your browser's developer console, retrieve the element using `document.getElementById("<globalId>_footer")`, where `<globalId>` is the generated runtime-unique ID.

To retrieve a component's global ID in JavaScript, use the `getGlobalId()` function.

```
var globalId = cmp.getGlobalId();
```

SEE ALSO:

[Finding Components by ID](#)

[Which Button Was Pressed?](#)

HTML in Components

An HTML tag is treated as a first-class component by the framework. Each HTML tag is translated into an `<aura:html>` component, allowing it to enjoy the same rights and privileges as any other component.

For example, the framework automatically converts a standard HTML `<div>` tag to this component:

```
<aura:html tag="div" />
```

You can add HTML markup in components. Note that you must use strict [XHTML](#). For example, use `
` instead of `
`. You can also use HTML attributes and DOM events, such as `onclick`.

 **Warning:** Some tags, like `<applet>` and ``, aren't supported.

Unescaping HTML

To output pre-formatted HTML, use `aura:unescapeHTML`. For example, this is useful if you want to display HTML that is generated on the server and add it to the DOM. You must escape any HTML if necessary or your app might be exposed to security vulnerabilities.

You can pass in values from an expression, such as in `<aura:unescapeHTML value="{!!v.note.body}"/>`.

`{ !expression }` is the framework's expression syntax. For more information, see [Using Expressions](#) on page 44.

IN THIS SECTION:[Supported HTML Tags](#)

The framework supports most HTML tags, including the majority of HTML5 tags.

SEE ALSO:[Supported HTML Tags](#)[CSS in Components](#)

Supported HTML Tags

The framework supports most HTML tags, including the majority of HTML5 tags.

We recommend that you use components in preference to HTML tags. For example, use `lightning:button` instead of `<button>`.

Components are designed with accessibility in mind so users with disabilities or those who use assistive technologies can also use your app. When you start building more complex components, the reusable out-of-the-box components can simplify your job by handling some of the plumbing that you would otherwise have to create yourself. Also, these components are secure and optimized for performance.

Note that you must use strict [XHTML](#). For example, use `
` instead of `
`.

Some HTML tags are unsafe or unnecessary. The framework doesn't support these tags.

The `HtmlTag` enum in [this open-source Aura file](#) lists the supported HTML tags. Any tag followed by `(false)` is not supported. For example, `applet(false)` means the `applet` tag isn't supported.



Note: The linked file is in the master branch of the open-source Aura project. The master branch is our current development branch and is ahead of the current release of the Aura Components programming model. However, this file changes infrequently and is the best place to see if a tag is supported now or in the near future.

IN THIS SECTION:[Anchor Tag: <a>](#)

Don't hard code or dynamically generate Salesforce URLs in the `href` attribute of an `<a>` tag. Use events, such as `force:navigateToSObject` or `force:navigateToURL`, instead.

SEE ALSO:[Supporting Accessibility](#)

Anchor Tag: `<a>`

Don't hard code or dynamically generate Salesforce URLs in the `href` attribute of an `<a>` tag. Use events, such as `force:navigateToSObject` or `force:navigateToURL`, instead.

Avoid the `href` Attribute

Using the `href` attribute of an `<a>` tag leads to inconsistent behavior in different apps and shouldn't be relied on. For example, don't use this markup to link to a record:

```
<a href="/XXXXXXXXXXXXXXXXXXXX">Salesforce record ID (DON'T DO THIS)</a>
```

If you use `#` in the `href` attribute, a secondary issue occurs. The hash mark (#) is a URL fragment identifier and is often used in Web development for navigation within a page. Avoid `#` in the `href` attribute of anchor tags in Lightning components as it can cause unexpected navigation changes, especially in the Salesforce app. That's another reason not to use `href`.

Use Navigation Events

Use one of the navigation events for consistent behavior across Lightning Experience, Salesforce app, and Lightning communities.

`force:navigateToList`

Navigates to a list view.

`force:navigateToObjectHome`

Navigates to an object home.

`force:navigateToRelatedList`

Navigates to a related list.

`force:navigateToSObject`

Navigates to a record.

`force:navigateToURL`

Navigates to a URL.

As well as consistent behavior, using navigation events instead of `<a>` tags reduces the number of full app reloads, leading to better performance.

Example Using Navigation Event

This example uses an `<a>` tag that's wired to a controller action, which fires the `force:navigateToSObject` event to navigate to a record. The `one.app` container handles the event. This event is supported in Lightning Experience, Salesforce app, and Lightning communities.

```
<!--c:navToRecord-->
<aura:component>
    <aura:attribute name="recordId" type="String" />

    <p><a onclick="{!!c.handleClick}">link to record</a></p>
</aura:component>
```

Here is the controller that fires the event.

```
/* navToRecordController.js */
({
    handleClick: function (component, event, helper) {
        var navEvt = $A.get("e.force:navigateToSObject");
        navEvt.setParams({
            "recordId": component.get("v.recordId")
        });
        navEvt.fire();
    }
})
```

The record ID is passed into `c:navToRecord` by setting its `recordId` attribute. When `c:navToRecord` is used in Lightning Experience, Salesforce app, or Lightning communities, the link navigates to the specified record.

CSS in Components

Style your components with CSS.

Add CSS to a component bundle by clicking the **STYLE** button in the Developer Console sidebar.



Note: You can't add a `<style>` tag in component markup or when you dynamically create a component in JavaScript code.

This restriction ensures better component encapsulation and prevents component styling interfering with the styling of another component. The `<style>` tag restriction applies to components with API version 42.0 or later.

For external CSS resources, see [Styling Apps](#) on page 299.

All top-level elements in a component have a special `THIS` CSS class added to them. This, effectively, adds namespacing to CSS and helps prevent one component's CSS from overriding another component's styling. The framework throws an error if a CSS file doesn't follow this convention.

Let's look at a sample `helloHTML cmp` component. The CSS is in `helloHTML.css`.

Component source

```
<aura:component>
  <div class="white">
    Hello, HTML!
  </div>

  <h2>Check out the style in this list.</h2>

  <ul>
    <li class="red">I'm red.</li>
    <li class="blue">I'm blue.</li>
    <li class="green">I'm green.</li>
  </ul>
</aura:component>
```

CSS source

```
.THIS {
  background-color: grey;
}

.THIS.white {
  background-color: white;
}

.THIS.red {
  background-color: red;
}

.THIS.blue {
  background-color: blue;
}

.THIS.green {
  background-color: green;
}
```

Output



The top-level elements, `h2` and `ul`, match the `THIS` class and render with a grey background. Top-level elements are tags wrapped by the HTML `body` tag and not by any other tags. In this example, the `li` tags are not top-level because they are nested in a `ul` tag.

The `<div class="white">` element matches the `.THIS.white` selector and renders with a white background. Note that there is no space in the selector as this rule is for top-level elements.

The `<li class="red">` element matches the `.THIS.red` selector and renders with a red background. Note that this is a descendant selector and it contains a space as the `` element is not a top-level element.

SEE ALSO:

[Adding and Removing Styles](#)

[HTML in Components](#)

Component Attributes

Component attributes are like member variables on a class in Apex. They are typed fields that are set on a specific instance of a component, and can be referenced from within the component's markup using an expression syntax. Attributes enable you to make components more dynamic.

Use the `<aura:attribute>` tag to add an attribute to the component or app. Let's look at the following sample, `helloAttributes.app`:

```
<aura:application>
    <aura:attribute name="whom" type="String" default="world"/>
    Hello {!v.whom}!
</aura:application>
```

All attributes have a name and a type. Attributes may be marked as required by specifying `required="true"`, and may also specify a default value.

In this case we've got an attribute named `whom` of type `String`. If no value is specified, it defaults to "world".

Though not a strict requirement, `<aura:attribute>` tags are usually the first things listed in a component's markup, as it provides an easy way to read the component's shape at a glance.

Attribute Naming Rules

An attribute name must follow these naming rules:

- Must begin with a letter or an underscore
- Must contain only alphanumeric or underscore characters

Expressions

`helloAttributes.app` contains an expression, `{ !v.whom }`, which is responsible for the component's dynamic output.

`{ !expression }` is the framework's expression syntax. In this case, the expression we are evaluating is `v.whom`. The name of the attribute we defined is `whom`, while `v` is the value provider for a component's attribute set, which represents the view.

 **Note:** Expressions are case sensitive. For example, if you have a custom field `myNamespace__Amount__c`, you must refer to it as `{ !v.myObject.myNamespace__Amount__c }`.

IN THIS SECTION:

[Supported aura:attribute Types](#)

`aura:attribute` describes an attribute available on an app, interface, component, or event.

[Basic Types](#)

[Function Type](#)

An attribute can have a type corresponding to a JavaScript function. If a child component has an attribute of this type, you can pass a callback from a parent component that contains the child component.

[Object Types](#)

[Standard and Custom Object Types](#)

[Collection Types](#)

[Custom Apex Class Types](#)

[Framework-Specific Types](#)

SEE ALSO:

[Supported aura:attribute Types](#)

[Using Expressions](#)

Supported aura:attribute Types

`aura:attribute` describes an attribute available on an app, interface, component, or event.

| Attribute Name | Type | Description |
|----------------------|--------|---|
| <code>access</code> | String | Indicates whether the attribute can be used outside of its own namespace. Possible values are <code>public</code> (default), and <code>global</code> , and <code>private</code> . |
| <code>name</code> | String | Required. The name of the attribute. For example, if you set <code><aura:attribute name="isTrue" type="Boolean" /></code> on a component called <code>aura:newCmp</code> , you can set this attribute when you instantiate the component; for example, <code><aura:newCmp isTrue="false" /></code> . |
| <code>type</code> | String | Required. The type of the attribute. For a list of basic types supported, see Basic Types . |
| <code>default</code> | String | The default value for the attribute, which can be overwritten as needed. When setting a default value, expressions using the <code>\$Label</code> , <code>\$Locale</code> , and <code>\$Browser</code> global value providers are supported. Alternatively, to set a dynamic default, use an <code>init</code> event. See Invoking Actions on Component Initialization on page 340. |

| Attribute Name | Type | Description |
|----------------|---------|--|
| required | Boolean | Determines if the attribute is required. The default is <code>false</code> . |
| description | String | A summary of the attribute and its usage. |

All `<aura:attribute>` tags have name and type values. For example:

```
<aura:attribute name="whom" type="String" />
```

 **Note:** Although type values are case insensitive, case sensitivity should be respected as your markup interacts with JavaScript, CSS, and Apex.

SEE ALSO:

[Component Attributes](#)

Basic Types

Here are the supported basic type values. Some of these types correspond to the wrapper objects for primitives in Java. Since the framework is written in Java, defaults, such as maximum size for a number, for these basic types are defined by the Java objects that they map to.

| type | Example | Description |
|----------|--|--|
| Boolean | <code><aura:attribute name="showDetail" type="Boolean" /></code> | Valid values are <code>true</code> or <code>false</code> . To set a default value of <code>true</code> , add <code>default="true"</code> . |
| Date | <code><aura:attribute name="startDate" type="Date" /></code> | A date corresponding to a calendar day in the format <code>yyyy-mm-dd</code> . The <code>hh:mm:ss</code> portion of the date is not stored. To include time fields, use <code>DateTime</code> instead. |
| DateTime | <code><aura:attribute name="lastModifiedDate" type="DateTime" /></code> | A date corresponding to a timestamp. It includes date and time details with millisecond precision. |
| Decimal | <code><aura:attribute name="totalPrice" type="Decimal" /></code> | Decimal values can contain fractional portions (digits to the right of the decimal). Maps to java.math.BigDecimal . Decimal is better than Double for maintaining precision for floating-point calculations. It's preferable for currency fields. |
| Double | <code><aura:attribute name="widthInchesFractional" type="Double" /></code> | Double values can contain fractional portions. Maps to java.lang.Double . Use Decimal for currency fields instead. |
| Integer | <code><aura:attribute name="numRecords" type="Integer" /></code> | Integer values can contain numbers with no fractional portion. Maps to java.lang.Integer , which defines its limits, such as maximum size. |

| type | Example | Description |
|--------|---|---|
| Long | <aura:attribute name="numSwissBankAccount" type="Long" /> | Long values can contain numbers with no fractional portion. Maps to <code>java.lang.Long</code> , which defines its limits, such as maximum size. Use this data type when you need a range of values wider than those provided by <code>Integer</code> . |
| String | <aura:attribute name="message" type="String" /> | A sequence of characters. |

You can use arrays for each of these basic types. For example:

```
<aura:attribute name="favoriteColors" type="String[]" default="['red','green','blue']" />
```

Retrieving Data from an Apex Controller

To retrieve the string array from an Apex controller, bind the component to the controller. This component retrieves the string array when a button is clicked.

```
<aura:component controller="namespace.AttributeTypes">
    <aura:attribute name="favoriteColors" type="String[]" default="cyan, yellow, magenta"/>

    <aura:iteration items="{!v.favoriteColors}" var="s">
        {!s}
    </aura:iteration>
    <lightning:button onclick="{!!c.getString()}" label="Update"/>
</aura:component>
```

Set the Apex controller to return a `List<String>` object.

```
public class AttributeTypes {
    private final String[] arrayItems;

    @AuraEnabled
    public static List<String> getStringArray() {
        String[] arrayItems = new String[]{ 'red', 'green', 'blue' };
        return arrayItems;
    }
}
```

This client-side controller retrieves the string array from the Apex controller and displays it using the `{!v.favoriteColors}` expression.

```
({
    getString : function(component, event) {
        var action = component.get("c.getStringArray");
        action.setCallback(this, function(response) {
            var state = response.getState();
            if (state === "SUCCESS") {
```

```
        var stringItems = response.getReturnValue();
        component.set("v.favoriteColors", stringItems);
    }
})
$A.enqueueAction(action);
}
})
```

Function Type

An attribute can have a type corresponding to a JavaScript function. If a child component has an attribute of this type, you can pass a callback from a parent component that contains the child component.

```
<aura:attribute name="callback" type="Function" />
```

For an example of using this type with `aura:method`, see [Return Result for Asynchronous Code](#).

 **Note:** Don't send attributes with `type="Function"` to the server. These attributes are intended to only be used on the client side.

The most robust way to communicate between components is to use an event. If you get an error in a component with an attribute of type `Function`, fire an event in the child component instead and handle it in the parent component.

Object Types

An attribute can have a type corresponding to an Object. For example:

```
<aura:attribute name="data" type="Object" />
```

 **Warning:** We recommend using `type="Map"` instead of `type="Object"` to avoid some deserialization issues on the server. For example, when an attribute of `type="Object"` is serialized to the server, everything is converted to a string. Deep expressions, such as `v.data.property` can throw an exception when they are evaluated as a string on the server. Using `type="Map"` avoids these exceptions for deep expressions, and other deserialization issues.

Checking for Types

To determine a variable type, use `typeof` or a standard JavaScript method instead. The `instanceof` operator is unreliable due to the potential presence of multiple windows or frames.

SEE ALSO:

[Working with Salesforce Records](#)

[Working with Salesforce Records](#)

Standard and Custom Object Types

An attribute can have a type corresponding to a standard or custom object. For example, this is an attribute for a standard `Account` object:

```
<aura:attribute name="acct" type="Account" />
```

This is an attribute for an `Expense__c` custom object:

```
<aura:attribute name="expense" type="Expense__c" />
```

SEE ALSO:

[Working with Salesforce Records](#)

[Working with Salesforce Records](#)

Collection Types

Here are the supported collection type values.

| type | Example | Description |
|-----------------------------|--|---|
| <code>type[]</code> (Array) | <pre><aura:attribute name="colorPalette" type="String[]" default="['red', 'green', 'blue']" /></pre> | <p>An array of items of a defined type.</p> <p> Note: To set a default value, surround comma-separated values with <code>[]</code>; for example <code>default="['red', 'green', 'blue']"</code>. Setting a default value without square brackets is deprecated and can lead to unexpected behavior.</p> |
| List | <pre><aura:attribute name="colorPalette" type="List" default="['red', 'green', 'blue']" /></pre> | <p>An ordered collection of items.</p> <p> Note: To set a default value, surround comma-separated values with <code>[]</code>; for example <code>default="['red', 'green', 'blue']"</code>. Setting a default value without square brackets is deprecated and can lead to unexpected behavior.</p> |
| Map | <pre><aura:attribute name="sectionLabels" type="Map" default="{ a: 'label1', b: 'label2' }" /></pre> | <p>A collection that maps keys to values. A map can't contain duplicate keys. Each key can map to at most one value. Defaults to an empty object, <code>{ }</code>. Retrieve values by using <code>cmp.get("v.sectionLabels")['a']</code>.</p> |
| Set | <pre><aura:attribute name="collection" type="Set" default="['red', 'green', 'blue']" /></pre> | <p>A collection that contains no duplicate elements. The order for set items is not guaranteed. For example, <code>['red', 'green', 'blue']</code> might be returned as <code>blue, green, red</code>.</p> <p> Note: To set a default value, surround comma-separated values with <code>[]</code>; for example <code>default="['red', 'green', 'blue']"</code>. Setting a default value without square brackets is deprecated and can lead to unexpected behavior.</p> |

Checking for Types

To determine a variable type, use `typeof` or a standard JavaScript method, such as `Array.isArray()`, instead. The `instanceof` operator is unreliable due to the potential presence of multiple windows or frames.

Setting List Items

There are several ways to set items in a list. To use a client-side controller, create an attribute of type List and set the items using `component.set()`.

This example retrieves a list of numbers from a client-side controller when a button is clicked.

```
<aura:attribute name="numbers" type="List"/>
<lightning:button onclick="{!!c.getNumbers}" label="Display Numbers" />
<aura:iteration var="num" items="{!!v.numbers}">
    {!num.value}
</aura:iteration>

/** Client-side Controller */
({
    getNumbers: function(component, event, helper) {
        var numbers = [];
        for (var i = 0; i < 20; i++) {
            numbers.push({
                value: i
            });
        }
        component.set("v.numbers", numbers);
    }
})
```

To retrieve list data from a controller, use `aura:iteration`.

Setting Map Items

To add a key and value pair to a map, use the syntax `myMap.set('myNewKey', myNewValue)`.

```
var myMap = cmp.get("v.sectionLabels");
myMap.set('c', 'label3');
```

The following example retrieves data from a map.

```
for (var key in myMap) {
    //do something
}
```

Custom Apex Class Types

An attribute can have a type corresponding to an Apex class. For example, this is an attribute for a custom `Color` Apex class:

```
<aura:attribute name="color" type="docSampleNamespace.Color" />
```

Component attribute types can be custom Apex classes, and the following standard Apex classes.

- List

- Map

To make use of values held in other Apex built-in classes, create a custom Apex class, and copy needed values from instances of the standard class into your custom class.

When an instance of an Apex class is returned from a server-side action, the instance is serialized to JSON by the framework. Only the values of `public` instance properties and methods annotated with `@AuraEnabled` are serialized and returned.

The following Apex data types can be serialized from `@AuraEnabled` properties and methods.

- Primitive types except for BLOB
- Object, subject to limitations described above
- sObject
- Collections types (List and Map) when they hold elements of a supported type

 **Note:** Custom classes used for component attributes shouldn't be inner classes or use inheritance. While these Apex language features might work in some situations, there are known issues, and their use is unsupported in all cases.

Using Arrays

If an attribute can contain more than one element, use an array.

This `aura:attribute` tag shows the syntax for an array of Apex objects:

```
<aura:attribute name="colorPalette" type="docSampleNamespace.Color[]" />
```

SEE ALSO:

- [Returning Data from an Apex Server-Side Controller](#)
- [AuraEnabled Annotation](#)
- [Working with Salesforce Records](#)
- [Returning Data from an Apex Server-Side Controller](#)
- [AuraEnabled Annotation](#)
- [Working with Salesforce Records](#)
- [Apex Developer Guide: Data Types](#)

Framework-Specific Types

Here are the supported type values that are specific to the framework.

| type | Example | Description |
|-------------------------------|---|--|
| <code>Aura.Component</code> | N/A | A single component. We recommend using <code>Aura.Component[]</code> instead. |
| <code>Aura.Component[]</code> | <pre><aura:attribute name="detail" type="Aura.Component[]" /></pre> <p>To set a default value for <code>type="Aura.Component[]"</code>, put</p> | Use this type to set blocks of markup. An attribute of type <code>Aura.Component[]</code> is called a facet. |

| type | Example | Description |
|--------------------------|---|---|
| | <p>the default markup in the body of <code>aura:attribute</code>. For example:</p> <pre data-bbox="605 354 964 656"><aura:component> <aura:attribute name="detail" type="Aura.Component[]"> <p>default paragraph1</p> </aura:attribute> Default value is: { !v.detail } </aura:component></pre> | |
| <code>Aura.Action</code> | <pre data-bbox="605 699 915 804"><aura:attribute name="onclick" type="Aura.Action"/></pre> | <p>Use this type to pass an action to a component. See Using the <code>Aura.Action</code> Attribute Type.</p> |

IN THIS SECTION:

[Using the `Aura.Action` Attribute Type](#)

An `Aura.Action` is a reference to an action in the framework. If a child component has an `Aura.Action` attribute, a parent component can pass in an action handler when it instantiates the child component in its markup. This pattern is a shortcut to pass a controller action from a parent component to a child component that it contains, and is used for `on*` handlers, such as `onclick`.

SEE ALSO:

- [Component Body](#)
- [Component Facets](#)
- [Component Body](#)
- [Component Facets](#)

Using the `Aura.Action` Attribute Type

An `Aura.Action` is a reference to an action in the framework. If a child component has an `Aura.Action` attribute, a parent component can pass in an action handler when it instantiates the child component in its markup. This pattern is a shortcut to pass a controller action from a parent component to a child component that it contains, and is used for `on*` handlers, such as `onclick`.

 **Warning:** Although `Aura.Action` works for passing an action handler to a child component, we recommend registering an event in the child component and firing the event in the child's controller instead. Then, handle the event in the parent component. The event approach requires a few extra steps in creating or choosing an event and firing it but events are the standard way to communicate between components.

`Aura.Action` shouldn't be used for other use cases. Here are some known limitations of `Aura.Action`.

- Don't use `cmp.set()` in JavaScript code to reset an attribute of `type="Aura.Action"` after it's previously been set. Doing so generates an error.

```
Unable to set value for key 'c.passedAction'. Value provider does not implement
'set(key, value)'. : false
```

- Don't use `$A.enqueueAction()` in the child component to enqueue the action passed to the `Aura.Action` attribute.

Example

This example demonstrates how to pass an action handler from a parent component to a child component.

Here's the child component with the `Aura.Action` attribute. The `onclick` handler for the button uses the value of the `onclick` attribute, which has type of `Aura.Action`.

```
<!-- child.cmp -->
<aura:component>
    <aura:attribute name="onclick" type="Aura.Action"/>

    <p>Child component with Aura.Action attribute</p>
    <lightning:button label="Execute the passed action" onclick="{!!v.onclick}" />
</aura:component>
```

Here's the parent component that contains the child component in its markup.

```
<!-- parent.cmp -->
<aura:component>
    <p>Parent component passes handler action to c:child</p>
    <c:child onclick="{!!c.parentAction}" />
</aura:component>
```

When you click the button in `c:child`, the `parentAction` action in the controller of `c:parent` is executed.

Instead of an `Aura.Action` attribute, you could use `<aura:registerEvent>` to register an `onclick` event in the child component. You'd have to define the event and create an action in the child's controller to fire the event. This event-based approach requires a few extra steps but it's more in line with standard practices for communicating between components.

SEE ALSO:

[Framework-Specific Types](#)
[Handling Events with Client-Side Controllers](#)
[Framework-Specific Types](#)
[Handling Events with Client-Side Controllers](#)

Using Expressions

Expressions allow you to make calculations and access property values and other data within component markup. Use expressions for dynamic output or passing values into components by assigning them to attributes.

An expression is any set of literal values, variables, sub-expressions, or operators that can be resolved to a single value. Method calls are not allowed in expressions.

The expression syntax is: `{ ! expression }`

expression is a placeholder for the expression.

Anything inside the `{ ! }` delimiters is evaluated and dynamically replaced when the component is rendered or when the value is used by the component. Whitespace is ignored.



Note: If you're familiar with other languages, you may be tempted to read the `!` as the “bang” operator, which negates boolean values in many programming languages. In the Aura Components programming model, `{ !` is simply the delimiter used to begin an expression.

If you're familiar with Visualforce, this syntax will look familiar.

Here's an example in component markup.

```
{ !v.firstName }
```

In this expression, `v` represents the view, which is the set of component attributes, and `firstName` is an attribute of the component. The expression outputs the `firstName` attribute value for the component.

The resulting value of an expression can be a primitive, such as an integer, string, or boolean. It can also be a JavaScript object, a component or collection, a controller method such as an action method, and other useful results.

There is a second expression syntax: `{ #expression }`. For more details on the difference between the two forms of expression syntax, see [Data Binding Between Components](#).

Identifiers in an expression, such as attribute names accessed through the view, controller values, or labels, must start with a letter or underscore. They can also contain numbers or hyphens after the first character. For example, `{ !v.2count }` is not valid, but `{ !v.count }` is.

Important: Only use the `{ ! }` syntax in markup in `.app` or `.cmp` files. In JavaScript, use string syntax to evaluate an expression. For example:

```
var theLabel = cmp.get("v.label");
```

If you want to escape `{ ! }`, use this syntax:

```
<aura:text value="{}!"/>
```

This renders `{ ! }` in plain text because the `aura:text` component never interprets `{ !` as the start of an expression.

IN THIS SECTION:

[Dynamic Output in Expressions](#)

The simplest way to use expressions is to output dynamic values.

[Conditional Expressions](#)

Here are examples of conditional expressions using the ternary operator and the `<aura:if>` tag.

[Data Binding Between Components](#)

When you add a component in markup, you can use an expression to initialize attribute values in the component based on attribute values of the container component. There are two forms of expression syntax, which exhibit different behaviors for data binding between the components.

[Value Providers](#)

Value providers are a way to access data. Value providers encapsulate related values together, similar to how an object encapsulates properties and methods.

[Expression Evaluation](#)

Expressions are evaluated much the same way that expressions in JavaScript or other programming languages are evaluated.

[Expression Operators Reference](#)

The expression language supports operators to enable you to create more complex expressions.

[Expression Functions Reference](#)

The expression language contains math, string, array, comparison, boolean, and conditional functions. All functions are case-sensitive.

Dynamic Output in Expressions

The simplest way to use expressions is to output dynamic values.

Values used in the expression can be from component attributes, literal values, booleans, and so on. For example:

```
{!v.desc}
```

In this expression, `v` represents the view, which is the set of component attributes, and `desc` is an attribute of the component. The expression is simply outputting the `desc` attribute value for the component that contains this markup.

If you're including literal values in expressions, enclose text values within single quotes, such as `{!'Some text'}`.

Include numbers without quotes, for example, `{!123}`.

For booleans, use `{!true}` for `true` and `{!false}` for `false`.

SEE ALSO:

[Component Attributes](#)[Value Providers](#)

Conditional Expressions

Here are examples of conditional expressions using the ternary operator and the `<aura:if>` tag.

Ternary Operator

This expression uses the ternary operator to conditionally output one of two values dependent on a condition.

```
<a class="{!v.location == '/active' ? 'selected' : ''}" href="#/active">Active</a>
```

The `{!v.location == '/active' ? 'selected' : ''}` expression conditionally sets the `class` attribute of an HTML `<a>` tag, by checking whether the `location` attribute is set to `/active`. If true, the expression sets `class` to `selected`.

Using `<aura:if>` for Conditional Markup

This snippet of markup uses the `<aura:if>` tag to conditionally display an edit button.

```
<aura:attribute name="edit" type="Boolean" default="true"/>
<aura:if isTrue="{!v.edit}">
  <ui:button label="Edit"/>
  <aura:set attribute="else">
    You can't edit this.
  </aura:set>
</aura:if>
```

If the `edit` attribute is set to `true`, a `ui:button` displays. Otherwise, the text in the `else` attribute displays.

SEE ALSO:

[Best Practices for Conditional Markup](#)

Data Binding Between Components

When you add a component in markup, you can use an expression to initialize attribute values in the component based on attribute values of the container component. There are two forms of expression syntax, which exhibit different behaviors for data binding between the components.

This concept is a little tricky, but it will make more sense when we look at an example. Consider a `c:parent` component that has a `parentAttr` attribute. `c:parent` contains a `c:child` component with a `childAttr` attribute that's initialized to the value of the `parentAttr` attribute. We're passing the `parentAttr` attribute value from `c:parent` into the `c:child` component, which results in a data binding, also known as a value binding, between the two components.

```
<!--c:parent-->
<aura:component>
    <aura:attribute name="parentAttr" type="String" default="parent attribute"/>

    <!-- Instantiate the child component -->
    <c:child childAttr="{!v.parentAttr}" />
</aura:component>
```

`{!v.parentAttr}` is a bound expression. Any change to the value of the `childAttr` attribute in `c:child` also affects the `parentAttr` attribute in `c:parent` and vice versa.

Now, let's change the markup from:

```
<c:child childAttr="{!v.parentAttr}" />
```

to:

```
<c:child childAttr="#{v.parentAttr}" />
```

`{#v.parentAttr}` is an unbound expression. Any change to the value of the `childAttr` attribute in `c:child` doesn't affect the `parentAttr` attribute in `c:parent` and vice versa.

Here's a summary of the differences between the forms of expression syntax.

{#expression} (Unbound Expressions)

Data updates behave as you would expect in JavaScript. Primitives, such as `String`, are passed by value, and data updates for the expression in the parent and child are decoupled.

Objects, such as `Array` or `Map`, are passed by reference, so changes to the data in the child propagate to the parent. However, change handlers in the parent aren't notified. The same behavior applies for changes in the parent propagating to the child.

{ !expression } (Bound Expressions)

Data updates in either component are reflected through bidirectional data binding in both components. Similarly, change handlers are triggered in both the parent and child components.

 **Tip:** Bi-directional data binding is expensive for performance and it can create hard-to-debug errors due to the propagation of data changes through nested components. We recommend using the `{#expression}` syntax instead when you pass an expression from a parent component to a child component unless you require bi-directional data binding.

Unbound Expressions

Let's look at another example of a `c:parentExpr` component that contains another component, `c:childExpr`.

Here is the markup for `c:childExpr`.

```
<!--c:childExpr-->
<aura:component>
    <aura:attribute name="childAttr" type="String" />

    <p>childExpr childAttr: {!v.childAttr}</p>
    <p><lightning:button label="Update childAttr"
        onclick=" {!c.updateChildAttr}" /></p>
</aura:component>
```

Here is the markup for `c:parentExpr`.

```
<!--c:parentExpr-->
<aura:component>
    <aura:attribute name="parentAttr" type="String" default="parent attribute"/>

    <!-- Instantiate the child component -->
    <c:childExpr childAttr="#">

```

The `c:parentExpr` component uses an unbound expression to set an attribute in the `c:childExpr` component.

```
<c:childExpr childAttr="#">

```

When we instantiate `childExpr`, we set the `childAttr` attribute to the value of the `parentAttr` attribute in `c:parentExpr`. Since the `{#v.parentAttr}` syntax is used, the `v.parentAttr` expression is not bound to the value of the `childAttr` attribute.

The `c:exprApp` application is a wrapper around `c:parentExpr`.

```
<!--c:exprApp-->
<aura:application>
    <c:parentExpr />
</aura:application>
```

In the Developer Console, click **Preview** in the sidebar for `c:exprApp` to view the app in your browser.

Both `parentAttr` and `childAttr` are set to "parent attribute", which is the default value of `parentAttr`.

Now, let's create a client-side controller for `c:childExpr` so that we can dynamically update the component. Here is the source for `childExprController.js`.

```
/* childExprController.js */
({
    updateChildAttr: function(cmp) {
        cmp.set("v.childAttr", "updated child attribute");
    }
})
```

In the Developer Console, click **Update Preview** for `c:exprApp`.

Press the **Update childAttr** button. This updates `childAttr` to “updated child attribute”. The value of `parentAttr` is unchanged since we used an unbound expression.

```
<c:childExpr childAttr="#v.parentAttr" />
```

Let's add a client-side controller for `c:parentExpr`. Here is the source for `parentExprController.js`.

```
/* parentExprController.js */
({
    updateParentAttr: function(cmp) {
        cmp.set("v.parentAttr", "updated parent attribute");
    }
})
```

In the Developer Console, click **Update Preview** for `c:exprApp`.

Press the **Update parentAttr** button. This time, `parentAttr` is set to “updated parent attribute” while `childAttr` is unchanged due to the unbound expression.

 **Warning:** Don't use a component's `init` event and client-side controller to initialize an attribute that is used in an unbound expression. The attribute will not be initialized. Use a bound expression instead. For more information on a component's `init` event, see [Invoking Actions on Component Initialization](#) on page 340.

Alternatively, you can wrap the component in another component. When you instantiate the wrapped component in the wrapper component, initialize the attribute value instead of initializing the attribute in the wrapped component's client-side controller.

Bound Expressions

Now, let's update the code to use a bound expression instead. Change this line in `c:parentExpr`:

```
<c:childExpr childAttr="#v.parentAttr" />
```

to:

```
<c:childExpr childAttr="!v.parentAttr" />
```

In the Developer Console, click **Update Preview** for `c:exprApp`.

Press the **Update childAttr** button. This updates both `childAttr` and `parentAttr` to “updated child attribute” even though we only set `v.childAttr` in the client-side controller of `childExpr`. Both attributes were updated since we used a bound expression to set the `childAttr` attribute.

Change Handlers and Data Binding

You can configure a component to automatically invoke a change handler, which is a client-side controller action, when a value in one of the component's attributes changes.

When you use a bound expression, a change in the attribute in the parent or child component triggers the change handler in both components. When you use an unbound expression, the change is not propagated between components so the change handler is only triggered in the component that contains the changed attribute.

Let's add change handlers to our earlier example to see how they are affected by bound versus unbound expressions.

Here is the updated markup for `c:childExpr`.

```
<!--c:childExpr-->
<aura:component>
```

```
<aura:attribute name="childAttr" type="String" />

<aura:handler name="change" value="{!v.childAttr}" action="{!!c.onChildAttrChange}"/>

<p>childExpr childAttr: {!v.childAttr}</p>
<p><lightning:button label="Update childAttr"
    onclick="{!!c.updateChildAttr}"/></p>
</aura:component>
```

Notice the `<aura:handler>` tag with `name="change"`, which signifies a change handler. `value="{!v.childAttr}"` tells the change handler to track the `childAttr` attribute. When `childAttr` changes, the `onChildAttrChange` client-side controller action is invoked.

Here is the client-side controller for `c:childExpr`.

```
/* childExprController.js */
({
    updateChildAttr: function(cmp) {
        cmp.set("v.childAttr", "updated child attribute");
    },
    onChildAttrChange: function(cmp, evt) {
        console.log("childAttr has changed");
        console.log("old value: " + evt.getParam("oldValue"));
        console.log("current value: " + evt.getParam("value"));
    }
})
```

Here is the updated markup for `c:parentExpr` with a change handler.

```
<!--c:parentExpr-->
<aura:component>
    <aura:attribute name="parentAttr" type="String" default="parent attribute"/>

    <aura:handler name="change" value="{!v.parentAttr}" action="{!!c.onParentAttrChange}"/>

    <!-- Instantiate the child component -->
    <c:childExpr childAttr="{!!v.parentAttr}" />

    <p>parentExpr parentAttr: {!v.parentAttr}</p>
    <p><lightning:button label="Update parentAttr"
        onclick="{!!c.updateParentAttr}"/></p>
</aura:component>
```

Here is the client-side controller for `c:parentExpr`.

```
/* parentExprController.js */
({
    updateParentAttr: function(cmp) {
        cmp.set("v.parentAttr", "updated parent attribute");
    },
    onParentAttrChange: function(cmp, evt) {
        console.log("parentAttr has changed");
        console.log("old value: " + evt.getParam("oldValue"));
```

```

        console.log("current value: " + evt.getParam("value"));
    }
}

```

In the Developer Console, click **Update Preview** for `c:exprApp`.

Open your browser's console (**More tools > Developer tools** in Chrome).

Press the **Update parentAttr** button. The change handlers for `c:parentExpr` and `c:childExpr` are both triggered as we're using a bound expression.

```
<c:childExpr childAttr="={!v.parentAttr}" />
```

Change `c:parentExpr` to use an unbound expression instead.

```
<c:childExpr childAttr="#{v.parentAttr}" />
```

In the Developer Console, click **Update Preview** for `c:exprApp`.

Press the **Update childAttr** button. This time, only the change handler for `c:childExpr` is triggered as we're using an unbound expression.

SEE ALSO:

[Detecting Data Changes with Change Handlers](#)

[Dynamic Output in Expressions](#)

[Component Composition](#)

Value Providers

Value providers are a way to access data. Value providers encapsulate related values together, similar to how an object encapsulates properties and methods.

The value providers for a component are `v` (view) and `c` (controller).

| Value Provider | Description | See Also |
|----------------|--|--|
| <code>v</code> | A component's attribute set. This value provider enables you to access the value of a component's attribute in the component's markup. | Component Attributes |
| <code>c</code> | A component's controller, which enables you to wire up event handlers and actions for the component | Handling Events with Client-Side Controllers |

All components have a `v` value provider, but aren't required to have a controller. Both value providers are created automatically when defined for a component.

 **Note:** Expressions are bound to the specific component that contains them. That component is also known as the attribute value provider, and is used to resolve any expressions that are passed to attributes of its contained components.

Global Value Providers

Global value providers are global values and methods that a component can use in expressions.

| Global Value Provider | Description | See Also |
|-----------------------|---|-------------------------------------|
| globalID | The <code>globalID</code> global value provider returns the global ID for a component. Every component has a unique <code>globalId</code> , which is the generated runtime-unique ID of the component instance. | Component IDs |
| \$Browser | The <code>\$Browser</code> global value provider returns information about the hardware and operating system of the browser accessing the application. | \$Browser |
| \$ContentAsset | The <code>\$ContentAsset</code> global value provider lets you reference images, style sheets, and JavaScript used as asset files in your lightning components. | \$ContentAsset |
| \$Label | The <code>\$Label</code> global value provider enables you to access labels stored outside your code. | Using Custom Labels |
| \$Locale | The <code>\$Locale</code> global value provider returns information about the current user's preferred locale. | \$Locale |
| \$Resource | The <code>\$Resource</code> global value provider lets you reference images, style sheets, and JavaScript code you've uploaded in static resources. | \$Resource |

Accessing Fields and Related Objects

Values in a value provider are accessed as named properties. To use a value, separate the value provider and the property name with a dot (period). For example, `v.body`. You can access value providers in markup or in JavaScript code.

When an attribute of a component is an object or other structured data (not a primitive value), access the values on that attribute using the same dot notation.

For example, `{ !v.accounts.id }` accesses the `id` field in the `accounts` record.

For deeply nested objects and attributes, continue adding dots to traverse the structure and access the nested values.

SEE ALSO:

[Dynamic Output in Expressions](#)

\$Browser

The `$Browser` global value provider returns information about the hardware and operating system of the browser accessing the application.

| Attribute | Description |
|------------|--|
| formFactor | Returns a <code>FormFactor</code> enum value based on the type of hardware the browser is running on. <ul style="list-style-type: none"> • DESKTOP for a desktop client • PHONE for a phone including a mobile phone with a browser and a smartphone |

| Attribute | Description |
|-----------------------------|---|
| | <ul style="list-style-type: none"> • TABLET for a tablet client (for which <code>isTablet</code> returns <code>true</code>) |
| <code>isAndroid</code> | Indicates whether the browser is running on an Android device (<code>true</code>) or not (<code>false</code>). |
| <code>isIOS</code> | Not available in all implementations. Indicates whether the browser is running on an iOS device (<code>true</code>) or not (<code>false</code>). |
| <code>isIPad</code> | Not available in all implementations. Indicates whether the browser is running on an iPad (<code>true</code>) or not (<code>false</code>). |
| <code>isiPhone</code> | Not available in all implementations. Indicates whether the browser is running on an iPhone (<code>true</code>) or not (<code>false</code>). |
| <code>isPhone</code> | Indicates whether the browser is running on a phone including a mobile phone with a browser and a smartphone (<code>true</code>), or not (<code>false</code>). |
| <code>isTablet</code> | Indicates whether the browser is running on an iPad or a tablet with Android 2.2 or later (<code>true</code>) or not (<code>false</code>). |
| <code>isWindowsPhone</code> | Indicates whether the browser is running on a Windows phone (<code>true</code>) or not (<code>false</code>). Note that this only detects Windows phones and does not detect tablets or other touch-enabled Windows 8 devices. |



Example: This example shows usage of the `$Browser` global value provider.

```
<aura:component>
    { !$Browser.isTablet}
    { !$Browser.isPhone}
    { !$Browser.isAndroid}
    { !$Browser.formFactor}
</aura:component>
```

Similarly, you can check browser information in a client-side controller using `$A.get()`.

```
({
    checkBrowser: function(component) {
        var device = $A.get("$Browser.formFactor");
        alert("You are using a " + device);
    }
})
```

\$ContentAsset

The `$ContentAsset` global value provider lets you reference images, style sheets, and JavaScript used as asset files in your Lightning components.

Reference `$ContentAsset` asset files by name instead of using cumbersome file paths or URLs. `$ContentAsset` provides sharing, versioning, and access control for all asset files, as well as options for mobile optimization and resizing of image files. You can use `$ContentAsset` in Lightning components markup and within JavaScript controller and helper code.

Using `$ContentAsset` in Component Markup

To reference a specific asset file in component markup, use `$ContentAsset.yourNamespace__assetName`. Orgs without a namespace can use `$ContentAsset.assetDeveloperName`. Use this syntax regardless of whether an asset is for authenticated or unauthenticated sessions. To reference a content asset within an archive, add `pathinarchive` as a parameter appended to the basic syntax: `$ContentAsset.yourNamespace__assetName + 'pathinarchive=images/sampleImage.jpg'`.

Here are a few examples.

Aura component referencing an image in an archive asset file:

```
<aura:component>
    
</aura:component>
```

Include CSS style sheets or JavaScript libraries in a component using the `<ltng:require>` tag.

Aura component using an asset file to style a `div` element:

Markup

```
<aura:component>
    <ltng:require styles=" {!$ContentAsset.bookStyle} "/>

    <!-- "bookName" is defined in an asset file with DeveloperName of "bookStyle" -->
    <div id="bookTitle" class="bookName">
        </div>
</aura:component>
```

Aura component displays data from a `testDisplayData` JavaScript asset file:

Markup

```
<aura:component>
    <ltng:require scripts=" {!$ContentAsset.testDisplayData}" afterScriptsLoaded=" {!c.displayData} "/>
    ...
    <aura:attribute name="TestData" type="String[]" ></aura:attribute>
    <div>
        <input type="text" id="sampleData" value ="{!v.TestData}" />
    </div>
    ...
</aura:component>
```

Controller

```
{
    displayData : function(component, event, helper) {
        var data = _datamap.getData();
        component.set("v.TestData", data);
    }
})
```

JavaScript (.js) Asset File with DeveloperName `testDisplayData`

```
window._datamap = (function() {
    var data = ["Agree", "Disagree", "Strongly Agree", "Strongly Disagree", "Not
```

```

    Applicable"];
    return {
        getData: function() {
            return data.join(", ");
        }
    };
}();

```

\$Locale

The `$Locale` global value provider returns information about the current user's preferred locale.

| Attribute | Description | Sample Value |
|---------------------------------|---|---|
| <code>country</code> | The ISO 3166 representation of the country code based on the language locale. | "US", "DE", "GB" |
| <code>currency</code> | The currency symbol. | "\$" |
| <code>currencyCode</code> | The ISO 4217 representation of the currency code. | "USD" |
| <code>decimal</code> | The decimal separator. | "." |
| <code>firstDayOfWeek</code> | The first day of the week, where 1 is Sunday. | 1 |
| <code>grouping</code> | The grouping separator. | "," |
| <code>isEasternNameStyle</code> | Specifies if a name is based on eastern style, for example, <code>last name first name [middle] [suffix]</code> . | false |
| <code>labelForToday</code> | The label for the Today link on the date picker. | "Today" |
| <code>language</code> | The language code based on the language locale. | "en", "de", "zh" |
| <code>langLocale</code> | The locale ID. | "en_US", "en_GB" |
| <code>nameOfMonths</code> | The full and short names of the calendar months | { fullName: "January", shortName: "Jan" } |
| <code>nameOfWeekdays</code> | The full and short names of the calendar weeks | { fullName: "Sunday", shortName: "SUN" } |
| <code>timezone</code> | The time zone ID. | "America/Los_Angeles" |
| <code>userLocaleCountry</code> | The country based on the current user's locale | "US" |
| <code>userLocaleLang</code> | The language based on the current user's locale | "en" |
| <code>variant</code> | Deprecated. The variation for a language dialect. | |

Number and Date Formatting

| Attribute | Description | Sample Value |
|---------------------|-----------------------------------|---|
| currencyformat | The currency format. | "¤#,##0.00;(¤#,##0.00)" ¤ represents the currency sign, which is replaced by the currency symbol. |
| dateFormat | The date format. | "MMM d, yyyy" |
| datetimeFormat | The date time format. | "MMM d, yyyy h:mm:ss a" |
| longDateFormat | The long date format. | "MMMM d, yyyy" |
| numberformat | The number format. | "#,##0.###" # represents a digit, the comma is a placeholder for the grouping separator, and the period is a placeholder for the decimal separator. Zero (0) replaces # to represent trailing zeros. |
| percentformat | The percentage format. | "#,#%" |
| shortDateFormat | The short date format. | "M/d/yyyy" |
| shortDatetimeFormat | The short date time format. | "M/d/yyyy h:mm a" |
| shortTimeFormat | The short time format. | "h:mm a" |
| timeFormat | The time format. | "h:mm:ss a" |
| zero | The character for the zero digit. | "0" |



Example: This example shows how to retrieve different \$Locale attributes.

Component source

```
<aura:component>
    {!$Locale.language}
    {!$Locale.timezone}
    {!$Locale.numberFormat}
    {!$Locale.currencyFormat}
</aura:component>
```

Similarly, you can check locale information in JavaScript using \$A.get().

```
({
    checkDevice: function(component) {
        var locale = $A.get("$Locale.language");
        alert("You are using " + locale);
```

```
    }
})
```

SEE ALSO:

[Localization](#)

\$Resource

The `$Resource` global value provider lets you reference images, style sheets, and JavaScript code you've uploaded in static resources.

Using `$Resource` lets you reference assets by name, without worrying about the gory details of URLs or file paths. You can use `$Resource` in Aura component markup and within JavaScript controller and helper code.

Using \$Resource in Component Markup

To reference a specific resource in component markup, use `$Resource.resourceName` within an expression. `resourceName` is the Name of the static resource. In a managed packaged, the resource name must include the package namespace prefix, such as `$Resource.yourNamespace__resourceName`. For a stand-alone static resource, such as an individual graphic or script, that's all you need. To reference an item within an archive static resource, add the rest of the path to the item using string concatenation. Here are a few examples.

```
<aura:component>
    <!-- Stand-alone static resources -->
    
    

    <!-- Asset from an archive static resource -->
    
    
</aura:component>
```

Include CSS style sheets or JavaScript libraries into a component using the `<ltng:require>` tag. For example:

```
<aura:component>
    <ltng:require
        styles="{!$Resource.SLDSv2 + '/assets/styles/lightning-design-system-ltng.css'}"
        scripts="{!$Resource.jsLibraries + '/jsLibOne.js'}"
        afterScriptsLoaded="{!c.scriptsLoaded}" />
</aura:component>
```

 **Note:** Due to a quirk in the way `$Resource` is parsed in expressions, use the `join` operator to include multiple `$Resource` references in a single attribute. For example, if you have more than one JavaScript library to include into a component the `scripts` attribute should be something like the following.

```
scripts="{!!join(',',
    $Resource.jsLibraries + '/jsLibOne.js',
    $Resource.jsLibraries + '/jsLibTwo.js')}"
```

Using \$Resource in JavaScript

To obtain a reference to a static resource in JavaScript code, use `$A.get('{$Resource.resourceName}')`.

`resourceName` is the Name of the static resource. In a managed packaged, the resource name must include the package namespace prefix, such as `$Resource.yourNamespace__resourceName`. For a stand-alone static resource, such as an individual graphic or script, that's all you need. To reference an item within an archive static resource, add the rest of the path to the item using string concatenation. For example:

```
({
    profileUrl: function(component) {
        var profUrl = $A.get('$Resource.SLDSv2') + '/assets/images/avatar1.jpg';
        alert("Profile URL: " + profUrl);
    }
})
```



Note: Static resources referenced in JavaScript aren't automatically added to packages. If your JavaScript depends on a resource that isn't referenced in component markup, add it manually to any packages the JavaScript code is included in.

\$Resource Considerations

Global value providers in the Aura Components programming model are, behind the scenes, implemented quite differently from global variables in Salesforce. Although `$Resource` looks like the global variable with the same name available in Visualforce, formula fields, and elsewhere, there are important differences. Don't use other documentation as a guideline for its use or behavior.

Here are two specific things to keep in mind about `$Resource` in the Aura Components programming model.

First, `$Resource` isn't available until the Aura Components programming model is loaded on the client. Some very simple components that are composed of only markup can be rendered server-side, where `$Resource` isn't available. To avoid this, when you create a new app, stub out a client-side controller to force components to be rendered on the client.

Second, if you've worked with the `$Resource` global variable, in Visualforce or elsewhere, you've also used the `URLFOR()` formula function to construct complete URLs to specific resources. There's nothing similar to `URLFOR()` in the Aura Components programming model. Instead, use simple string concatenation, as illustrated in the preceding examples.

SEE ALSO:

[Salesforce Help: Static Resources](#)

Expression Evaluation

Expressions are evaluated much the same way that expressions in JavaScript or other programming languages are evaluated.

Operators are a subset of those available in JavaScript, and evaluation order and precedence are generally the same as JavaScript. Parentheses enable you to ensure a specific evaluation order. What you may find surprising about expressions is how often they are evaluated. The framework notices when things change, and trigger re-rendering of any components that are affected. Dependencies are handled automatically. This is one of the fundamental benefits of the framework. It knows when to re-render something on the page. When a component is re-rendered, any expressions it uses will be re-evaluated.

Action Methods

Expressions are also used to provide action methods for user interface events: `onclick`, `onhover`, and any other component attributes beginning with "on".

Action methods must be assigned to attributes using an expression, for example `{!c.theAction}`. This expression assigns a reference to the controller function that handles the action.

Assigning action methods via expressions allows you to assign them conditionally, based on the state of the application or user interface. For more information, see [Conditional Expressions](#) on page 46.

```
<aura:component>
  <aura:attribute name="liked" type="Boolean" default="true"/>
  <lightning:button aura:id="likeBtn"
    label="{!(v.liked) ? 'Like It' : 'Unlike It'}"
    onclick="{!(v.liked) ? c.likeIt : c.unlikeIt}"
  />
</aura:component>
```

This button will show "Like It" for items that have not yet been liked, and clicking it will call the `likeIt` action method. Then the component will re-render, and the opposite user interface display and method assignment will be in place. Clicking a second time will unlike the item, and so on.

 **Note:** The example demonstrates how attributes can help you control the state of a button. To create a button that toggles between states, we recommend using the `lightning:buttonStateful` component.

Expression Operators Reference

The expression language supports operators to enable you to create more complex expressions.

Arithmetic Operators

Expressions based on arithmetic operators result in numerical values.

| Operator | Usage | Description |
|----------|--------|--|
| + | 1 + 1 | Add two numbers. |
| - | 2 - 1 | Subtract one number from the other. |
| * | 2 * 2 | Multiply two numbers. |
| / | 4 / 2 | Divide one number by the other. |
| % | 5 % 2 | Return the integer remainder of dividing the first number by the second. |
| - | -v.exp | Unary operator. Reverses the sign of the succeeding number. For example if the value of <code>expenses</code> is 100, then <code>-expenses</code> is -100. |

Numeric Literals

| Literal | Usage | Description |
|---------|-----------------|--|
| Integer | 2 | Integers are numbers without a decimal point or exponent. |
| Float | 3.14 -1.1e10 | Numbers with a decimal point, or numbers with an exponent. |

| Literal | Usage | Description |
|---------|-------|--|
| Null | null | A literal null number. Matches the explicit null value and numbers with an undefined value. |

String Operators

Expressions based on string operators result in string values.

| Operator | Usage | Description |
|----------|--------------------------|------------------------------------|
| + | 'Title: ' + v.note.title | Concatenates two strings together. |

String Literals

String literals must be enclosed in single quotation marks 'like this'.

| Literal | Usage | Description |
|-----------|---------------|--|
| string | 'hello world' | Literal strings must be enclosed in single quotation marks. Double quotation marks are reserved for enclosing attribute values, and must be escaped in strings. |
| \<escape> | '\n' | <p>Whitespace characters:</p> <ul style="list-style-type: none"> • \t (tab) • \n (newline) • \r (carriage return) <p>Escaped characters:</p> <ul style="list-style-type: none"> • \" (literal ") • \' (literal ') • \\ (literal \) |
| Unicode | '\u####' | A Unicode code point. The # symbols are hexadecimal digits. A Unicode literal requires four digits. |
| null | null | A literal null string. Matches the explicit null value and strings with an undefined value. |

Comparison Operators

Expressions based on comparison operators result in a `true` or `false` value. For comparison purposes, numbers are treated as the same type. In all other cases, comparisons check both value and type.

| Operator | Alternative | Usage | Description |
|--------------------|-----------------|---|---|
| <code>==</code> | <code>eq</code> | <pre>1 == 1 1 == 1.0 1 eq 1</pre> <p> Note: <code>undefined==null</code> evaluates to <code>true</code>.</p> | Returns <code>true</code> if the operands are equal. This comparison is valid for all data types. |
| <code>!=</code> | <code>ne</code> | <pre>1 != 2 1 != true 1 != '1' null != false 1 ne 2</pre> | Returns <code>true</code> if the operands are not equal. This comparison is valid for all data types. |
| <code><</code> | <code>lt</code> | <pre>1 < 2 1 lt 2</pre> | Returns <code>true</code> if the first operand is numerically less than the second. You must escape the <code><</code> operator to <code>&lt;</code> to use it in component markup. Alternatively, you can use the <code>lt</code> operator. |
| <code>></code> | <code>gt</code> | <pre>42 > 2 42 gt 2</pre> | Returns <code>true</code> if the first operand is numerically greater than the second. |
| <code><=</code> | <code>le</code> | <pre>2 <= 42 2 le 42</pre> | Returns <code>true</code> if the first operand is numerically less than or equal to the second. You must escape the <code><=</code> operator to <code>&lt;=</code> to use it in component markup. Alternatively, you can use the <code>le</code> operator. |
| <code>>=</code> | <code>ge</code> | <pre>42 >= 42 42 ge 42</pre> | Returns <code>true</code> if the first operand is numerically greater than or equal to the second. |

Logical Operators

Expressions based on logical operators result in a `true` or `false` value.

| Operator | Usage | Description |
|-------------------------|---|---|
| <code>&&</code> | <code>isEnabled</code> <code>&&</code> <code>hasPermission</code> | Returns <code>true</code> if both operands are individually true. This syntax is awkward in markup so we recommend the alternative of using the <code>and()</code> function and passing it two arguments. For example, <code>and(isEnabled, hasPermission)</code> . |
| <code> </code> | <code>hasPermission</code> <code> </code> <code>isRequired</code> | Returns <code>true</code> if either operand is individually true. |
| <code>!</code> | <code>isRequired</code> | Unary operator. Returns <code>true</code> if the operand is <code>false</code> . This operator should not be confused with the <code>!</code> delimiter used to start an expression in <code>{ !</code> . You can combine the expression |

| Operator | Usage | Description |
|----------|-------|--|
| | | delimiter with this negation operator to return the logical negation of a value, for example, <code>{ !!true }</code> returns <code>false</code> . |

Logical Literals

Logical values are never equivalent to non-logical values. That is, only `true == true`, and only `false == false`; `1 != true`, and `0 != false`, and `null != false`.

| Literal | Usage | Description |
|--------------------|--------------------|-------------------------------------|
| <code>true</code> | <code>true</code> | A boolean <code>true</code> value. |
| <code>false</code> | <code>false</code> | A boolean <code>false</code> value. |

Conditional Operator

There is only one conditional operator, the traditional ternary operator.

| Operator | Usage | Description |
|------------------|--|---|
| <code>? :</code> | <code>(1 != 2) ? "Obviously" : "Black is White"</code> | The operand before the <code>?</code> operator is evaluated as a boolean. If true, the second operand is returned. If false, the third operand is returned. |

SEE ALSO:

[Expression Functions Reference](#)

Expression Functions Reference

The expression language contains math, string, array, comparison, boolean, and conditional functions. All functions are case-sensitive.

Math Functions

The math functions perform math operations on numbers. They take numerical arguments. The Corresponding Operator column lists equivalent operators, if any.

| Function | Alternative | Usage | Description | Corresponding Operator |
|-------------------|-----------------------|--------------------------|---|------------------------|
| <code>add</code> | <code>concat</code> | <code>add(1, 2)</code> | Adds the first argument to the second. | <code>+</code> |
| <code>sub</code> | <code>subtract</code> | <code>sub(10, 2)</code> | Subtracts the second argument from the first. | <code>-</code> |
| <code>mult</code> | <code>multiply</code> | <code>mult(2, 10)</code> | Multiplies the first argument by the second. | <code>*</code> |

| Function | Alternative | Usage | Description | Corresponding Operator |
|----------|-------------|----------|---|------------------------|
| div | divide | div(4,2) | Divides the first argument by the second. | / |
| mod | modulus | mod(5,2) | Returns the integer remainder resulting from dividing the first argument by the second. | % |
| abs | | abs(-5) | Returns the absolute value of the argument: the same number if the argument is positive, and the number without its negative sign if the number is negative. For example, abs(-5) is 5. | None |
| neg | negate | neg(100) | Reverses the sign of the argument. For example, neg(100) is -100. | - (unary) |

String Functions

| Function | Alternative | Usage | Description | Corresponding Operator |
|----------|-------------|--|---|------------------------|
| concat | add | concat('Hello ', 'world') add('Walk ', 'the dog') | Concatenates the two arguments. | + |
| format | | format(\${Label.ns.labelName}, v.myVal)  Note: This function works for arguments of type String, Decimal, Double, Integer, Long, Array, String[], List, and Set. | Replaces any parameter placeholders with comma-separated attribute values. | |
| join | | join(separator, subStr1, subStr2, subStrN) join(' ', 'class1', 'class2', v.class) | Joins the substrings adding the separator String (first argument) between each subsequent argument. | |

Label Functions

| Function | Usage | Description |
|----------|--|---|
| format | <pre>format(\${Label.np.labelName, v.attribute1, v.attribute2}) format(\${Label.np.hello, v.name})</pre> | Outputs a label and updates it. Replaces any parameter placeholders with comma-separated attribute values. Supports ternary operators in labels and attributes. |

Informational Functions

| Function | Usage | Description |
|----------|-------------------------------------|--|
| length | <code>myArray.length</code> | Returns the length of an array or a string. |
| empty | <code>empty(v.attributeName)</code> | <p>Returns <code>true</code> if the argument is empty. An empty argument is <code>undefined</code>, <code>null</code>, an empty array, or an empty string. An object with no properties is not considered empty.</p> <p> Note: This function works for arguments of type <code>String</code>, <code>Array</code>, <code>Object</code>, <code>List</code>, <code>Map</code>, or <code>Set</code>.</p> <p> Tip: <code>{ ! empty(v.myArray) }</code> evaluates faster than <code>{ !v.myArray && v.myArray.length > 0 }</code> so we recommend <code>empty()</code> to improve performance.</p> <p>The <code>\$A.util.isEmpty()</code> method in JavaScript is equivalent to the <code>empty()</code> expression in markup.</p> |

Comparison Functions

Comparison functions take two number arguments and return `true` or `false` depending on the comparison result. The `eq` and `ne` functions can also take other data types for their arguments, such as strings.

| Function | Usage | Description | Corresponding Operator |
|-----------|-----------------------------|--|--------------------------------------|
| equals | <code>equals(1,1)</code> | Returns <code>true</code> if the specified arguments <code>==</code> or <code>eq</code> are equal. The arguments can be any data type. | |
| notequals | <code>notequals(1,2)</code> | Returns <code>true</code> if the specified arguments <code>!=</code> or <code>ne</code> are not equal. The arguments can be any data type. | |
| lessthan | <code>lessthan(1,5)</code> | Returns <code>true</code> if the first argument is numerically less than the second argument. | <code><</code> or <code>lt</code> |

| Function | Usage | Description | Corresponding Operator |
|--------------------|-------------------------|--|------------------------|
| greaterthan | greaterthan(5,1) | Returns <code>true</code> if the first argument is numerically greater than the second argument. | > or gt |
| lessthanorequal | lessthanorequal(1,2) | Returns <code>true</code> if the first argument is numerically less than or equal to the second argument. | <= or le |
| greaterthanorequal | greaterthanorequal(2,1) | Returns <code>true</code> if the first argument is numerically greater than or equal to the second argument. | >= or ge |

Boolean Functions

Boolean functions operate on Boolean arguments. They are equivalent to logical operators.

| Function | Usage | Description | Corresponding Operator |
|----------|-------------------------------|--|------------------------|
| and | and(isEnabled, hasPermission) | Returns <code>true</code> if both arguments are true. This syntax is awkward in markup so we recommend using the <code>and</code> function instead. | & & |
| or | or(hasPermission, hasVIPPass) | Returns <code>true</code> if either one of the arguments is true. | |
| not | not(isNew) | Returns <code>true</code> if the argument <code>!</code> is false. | ! |

Conditional Function

| Function | Usage | Description | Corresponding Operator |
|----------|---|---|------------------------|
| if | if(isEnabled, 'Enabled', 'Not enabled') | Evaluates the first argument as a boolean. If true, returns the second argument. Otherwise, returns the third argument. | ? : (ternary) |

Component Composition

Composing fine-grained components in a larger component enables you to build more interesting components and applications.

Let's see how we can fit components together. We will first create a few simple components: `c:helloHTML` and `c:helloAttributes`. Then, we'll create a wrapper component, `c:nestedComponents`, that contains the simple components.

Here is the source for `helloHTML.cmp`.

```
<!--c:helloHTML-->
<aura:component>
    <div class="white">
        Hello, HTML!
    </div>

    <h2>Check out the style in this list.</h2>

    <ul>
        <li class="red">I'm red.</li>
        <li class="blue">I'm blue.</li>
        <li class="green">I'm green.</li>
    </ul>
</aura:component>
```

CSS source

```
.THIS {
    background-color: grey;
}

.THIS.white {
    background-color: white;
}

.THIS.red {
    background-color: red;
}

.THIS.blue {
    background-color: blue;
}

.THIS.green {
    background-color: green;
}
```

Output



Here is the source for `helloAttributes.cmp`.

```
<!--c:helloAttributes-->
<aura:component>
    <aura:attribute name="whom" type="String" default="world"/>
    Hello {!v.whom}!
</aura:component>
```

`nestedComponents.cmp` uses composition to include other components in its markup.

```
<!--c:nestedComponents-->
<aura:component>
```

```
Observe! Components within components!

<c:helloHTML/>

<c:helloAttributes whom="component composition"/>
</aura:component>
```

Output

Observe! Components within components!

Hello, HTML!

Check out the style in this list.

- I'm red.
- I'm blue.
- I'm green.

Hello component composition!

Including an existing component is similar to including an HTML tag. Reference the component by its "descriptor", which is of the form `namespace:component`. `nestedComponents.cmp` references the `helloHTML.cmp` component, which lives in the `c` namespace. Hence, its descriptor is `c:helloHTML`.

Note how `nestedComponents.cmp` also references `c:helloAttributes`. Just like adding attributes to an HTML tag, you can set attribute values in a component as part of the component tag. `nestedComponents.cmp` sets the `whom` attribute of `helloAttributes.cmp` to "component composition".

Attribute Passing

You can also pass attributes to nested components. `nestedComponents2.cmp` is similar to `nestedComponents.cmp`, except that it includes an extra `passthrough` attribute. This value is passed through as the attribute value for `c:helloAttributes`.

```
<!--c:nestedComponents2-->
<aura:component>
  <aura:attribute name="passthrough" type="String" default="passed attribute"/>
  Observe! Components within components!

  <c:helloHTML/>

  <c:helloAttributes whom="#v.passthrough"/>
</aura:component>
```

Output

Observe! Components within components!

Hello, HTML!

Check out the style in this list.

- I'm red.
- I'm blue.
- I'm green.

Hello passed attribute!

`helloAttributes` is now using the passed through attribute value.

 **Note:** `{#v.passthrough}` is an unbound expression. This means that any change to the value of the `whom` attribute in `c:helloAttributes` doesn't propagate back to affect the value of the `passthrough` attribute in `c:nestedComponents2`. For more information, see [Data Binding Between Components](#) on page 47.

Definitions versus Instances

In object-oriented programming, there's a difference between a class and an instance of that class. Components have a similar concept. When you create a `.cmp` resource, you are providing the definition (class) of that component. When you put a component tag in a `.cmp`, you are creating a reference to (instance of) that component.

It shouldn't be surprising that we can add multiple instances of the same component with different attributes.

`nestedComponents3.cmp` adds another instance of `c:helloAttributes` with a different attribute value. The two instances of the `c:helloAttributes` component have different values for their `whom` attribute.

```
<!--c:nestedComponents3-->
<aura:component>
    <aura:attribute name="passthrough" type="String" default="passed attribute"/>
    Observe! Components within components!

    <c:helloHTML/>

    <c:helloAttributes whom="#v.passthrough"/>

    <c:helloAttributes whom="separate instance"/>
</aura:component>
```

Output

Observe! Components within components!
Hello, HTML!

Check out the style in this list.

- I'm red
- I'm blue
- I'm green

Hello passed attribute! Hello separate instance!

Component Body

The root-level tag of every component is `<aura:component>`. Every component inherits the `body` attribute from `<aura:component>`.

The `<aura:component>` tag can contain tags, such as `<aura:attribute>`, `<aura:registerEvent>`, `<aura:handler>`, `<aura:set>`, and so on. Any free markup that is not enclosed in one of the tags allowed in a component is assumed to be part of the body and is set in the `body` attribute.

The `body` attribute has type `Aura.Component []`. It can be an array of one component, or an empty array, but it's always an array.

In a component, use "`v`" to access the collection of attributes. For example, `{ !v.body }` outputs the body of the component.

Setting the Body Content

To set the `body` attribute in a component, add free markup within the `<aura:component>` tag. For example:

```
<aura:component>
    <!--START BODY-->
    <div>Body part</div>
    <lightning:button label="Push Me" onclick="{!c.doSomething}"/>
    <!--END BODY-->
</aura:component>
```

To set the value of an inherited attribute, use the `<aura:set>` tag. Setting the body content is equivalent to wrapping that free markup inside `<aura:set attribute="body">`. Since the `body` attribute has this special behavior, you can omit `<aura:set attribute="body">`.

The previous sample is a shortcut for this markup. We recommend the less verbose syntax in the previous sample.

```
<aura:component>
    <aura:set attribute="body">
        <!--START BODY-->
        <div>Body part</div>
        <lightning:button label="Push Me" onclick="{!!c.doSomething}"/>
        <!--END BODY-->
    </aura:set>
</aura:component>
```

The same logic applies when you use any component that has a `body` attribute, not just `<aura:component>`. For example:

```
<lightning:tabset>
    <lightning:tab label="Tab 1">
        Hello world!
    </lightning:tab>
</lightning:tabset>
```

This is a shortcut for:

```
<lightning:tabset>
    <lightning:tab label="Tab 1">
        <aura:set attribute="body">
            Hello World!
        </aura:set>
    </lightning:tab>
</lightning:tabset>
```

Accessing the Component Body

To access a component body in JavaScript, use `component.get("v.body")`.

SEE ALSO:

[aura:set](#)

[Working with a Component Body in JavaScript](#)

Component Facets

A facet is any attribute of type `Aura.Component[]`. The `body` attribute is an example of a facet.

To define your own facet, add an `aura:attribute` tag of type `Aura.Component[]` to your component. For example, let's create a new component called `facetHeader.cmp`.

```
<!--c:facetHeader-->
<aura:component>
    <aura:attribute name="header" type="Aura.Component[]"/>

    <div>
```

```

<span class="header">{!v.header}</span><br/>
<span class="body">{!v.body}</span>
</div>
</aura:component>

```

This component has a header facet. Note how we position the output of the header using the `v.header` expression.

The component doesn't have any output when you access it directly as the `header` and `body` attributes aren't set. Let's create another component, `helloFacets.cmp`, that sets these attributes.

```

<!--c:helloFacets-->
<aura:component>
    See how we set the header facet.<br/>

    <c:facetHeader>

        Nice body!

        <aura:set attribute="header">
            Hello Header!
        </aura:set>
    </c:facetHeader>

</aura:component>

```

Note that `aura:set` sets the value of the `header` attribute of `facetHeader.cmp`, but you don't need to use `aura:set` if you're setting the `body` attribute.

SEE ALSO:

[Component Body](#)

Controlling Access

The framework enables you to control access to your applications, attributes, components, events, interfaces, and methods via the `access` system attribute. The `access` system attribute indicates whether the resource can be used outside of its own namespace.

Use the `access` system attribute on these tags:

- `<aura:application>`
- `<aura:attribute>`
- `<aura:component>`
- `<aura:event>`
- `<aura:interface>`
- `<aura:method>`

Access Values

You can specify these values for the `access` system attribute.

private

Available within the component, app, interface, event, or method and can't be referenced outside the resource. This value can only be used for `<aura:attribute>` or `<aura:method>`.

Marking an attribute as private makes it easier to refactor the attribute in the future as the attribute can only be used within the resource.

Accessing a private attribute returns `undefined` unless you reference it from the component in which it's declared. You can't access a private attribute from a sub-component that extends the component containing the private attribute.

public

Available within your org only. This is the default access value.

global

Available in all orgs.

 **Note:** Mark your resources, such as a component, with `access="global"` to make the resource usable outside of your own org. For example, if you want a component to be usable in an installed package or by a Lightning App Builder user or a Community Builder user in another org.

Example

This sample component has global access.

```
<aura:component access="global">
  ...
</aura:component>
```

Access Violations

If your code accesses a resource, such as a component, that doesn't have an `access` system attribute allowing you to access the resource:

- Client-side code doesn't execute or returns `undefined`. If you enabled debug mode, you see an error message in your browser console.
- Server-side code results in the component failing to load. If you enabled debug mode, you see a popup error message.

Anatomy of an Access Check Error Message

Here is a sample access check error message for an access violation.

```
Access Check Failed ! ComponentService.getDef() : 'markup://c:targetComponent' is not visible to 'markup://c:sourceComponent'.
```

An error message has four parts:

1. The context (who is trying to access the resource). In our example, this is `markup://c:sourceComponent`.
2. The target (the resource being accessed). In our example, this is `markup://c:targetComponent`.
3. The type of failure. In our example, this is `not visible`.
4. The code that triggered the failure. This is usually a class method. In our example, this is `ComponentService.getDef()`, which means that the target definition (component) was not accessible. A definition describes metadata for a resource, such as a component.

Fixing Access Check Errors

 **Tip:** If your code isn't working as you expect, enable debug mode to get better error reporting.

You can fix access check errors using one or more of these techniques.

- Add appropriate `access` system attributes to the resources that you own.
- Remove references in your code to resources that aren't available. In the earlier example, `markup://c:targetComponent` doesn't have an access value allowing `markup://c:sourceComponent` to access it.
- Ensure that an attribute that you're accessing exists by looking at its `<aura:attribute>` definition. Confirm that you're using the correct case-sensitive spelling for the name.

Accessing an undefined attribute or an attribute that is out of scope, for example a private attribute, triggers the same access violation message. The access context doesn't know whether the attribute is undefined or inaccessible.

Example: is not visible to 'undefined'

```
ComponentService.getDef():'markup://c:targetComponent' is not visible to 'undefined'
```

The key word in this error message is `undefined`, which indicates that the framework has lost context. This happens when your code accesses a component outside the normal framework lifecycle, such as in a `setTimeout()` or `setInterval()` call or in an ES6 Promise.

Fix this error by wrapping the code in a `$A.getCallback()` call. For more information, see [Modifying Components Outside the Framework Lifecycle](#).

Example: Cannot read property 'Yb' of undefined

```
Action failed: c$sourceComponent$controller$doInit [Cannot read property 'Yb' of undefined]
```

This error message happens when you reference a property on a variable with a value of `undefined`. The error can happen in many contexts, one of which is the side-effect of an access check failure. For example, let's see what happens when you try to access an `undefined` attribute, `imaginaryAttribute`, in JavaScript.

```
var whatDoYouExpect = cmp.get("v.imaginaryAttribute");
```

This is an access check error and `whatDoYouExpect` is set to `undefined`. Now, if you try to access a property on `whatDoYouExpect`, you get an error.

```
Action failed: c$sourceComponent$controller$doInit [Cannot read property 'Yb' of undefined]
```

The `c$sourceComponent$controller$doInit` portion of the error message tells you that the error is in the `doInit` method of the controller of the `sourceComponent` component in the `c` namespace.

IN THIS SECTION:

[Application Access Control](#)

The `access` attribute on the `aura:application` tag controls whether the app can be used outside of the app's namespace.

[Interface Access Control](#)

The `access` attribute on the `aura:interface` tag controls whether the interface can be used outside of the interface's namespace.

[Component Access Control](#)

The `access` attribute on the `aura:component` tag controls whether the component can be used outside of the component's namespace.

[Attribute Access Control](#)

The `access` attribute on the `aura:attribute` tag controls whether the attribute can be used outside of the attribute's namespace.

[Event Access Control](#)

The `access` attribute on the `aura:event` tag controls whether the event can be used outside of the event's namespace.

SEE ALSO:

[Enable Debug Mode for Lightning Components](#)

Application Access Control

The `access` attribute on the `aura:application` tag controls whether the app can be used outside of the app's namespace.

Possible values are listed below.

| Modifier | Description |
|---------------------|---|
| <code>public</code> | Available within your org only. This is the default access value. |
| <code>global</code> | Available in all orgs. |

Interface Access Control

The `access` attribute on the `aura:interface` tag controls whether the interface can be used outside of the interface's namespace.

Possible values are listed below.

| Modifier | Description |
|---------------------|---|
| <code>public</code> | Available within your org only. This is the default access value. |
| <code>global</code> | Available in all orgs. |

A component can implement an interface using the `implements` attribute on the `aura:component` tag.

Component Access Control

The `access` attribute on the `aura:component` tag controls whether the component can be used outside of the component's namespace.

Possible values are listed below.

| Modifier | Description |
|---------------------|---|
| <code>public</code> | Available within your org only. This is the default access value. |

| Modifier | Description |
|----------|------------------------|
| global | Available in all orgs. |

 **Note:** Components aren't directly addressable via a URL. To check your component output, embed your component in a `.app` resource.

Attribute Access Control

The `access` attribute on the `aura:attribute` tag controls whether the attribute can be used outside of the attribute's namespace.

Possible values are listed below.

| Access | Description |
|---------|---|
| private | Available within the component, app, interface, event, or method and can't be referenced outside the resource. |
| |  Note: Accessing a private attribute returns <code>undefined</code> unless you reference it from the component in which it's declared. You can't access a private attribute from a sub-component that extends the component containing the private attribute. |
| public | Available within your org only. This is the default access value. |
| global | Available in all orgs. |

Event Access Control

The `access` attribute on the `aura:event` tag controls whether the event can be used outside of the event's namespace.

Possible values are listed below.

| Modifier | Description |
|----------|---|
| public | Available within your org only. This is the default access value. |
| global | Available in all orgs. |

Using Object-Oriented Development

The framework provides the basic constructs of inheritance and encapsulation from object-oriented programming and applies them to presentation layer development.

For example, components are encapsulated and their internals stay private. Consumers of the component can access the public shape (attributes and registered events) of the component, but can't access other implementation details in the component bundle. This strong separation gives component authors freedom to change the internal implementation details and insulates component consumers from those changes.

You can extend a component, app, or interface, or you can implement a component interface.

What is Inherited?

This topic lists what is inherited when you extend a definition, such as a component.

When a component contains another component, we refer in the documentation to parent and child components in the containment hierarchy. When a component extends another component, we refer to sub and super components in the inheritance hierarchy.

Component Attributes

A sub component that extends a super component inherits the attributes of the super component. Use `<aura:set>` in the markup of a sub component to set the value of an attribute inherited from a super component.

Events

A sub component that extends a super component can handle events fired by the super component. The sub component automatically inherits the event handlers from the super component.

The super and sub component can handle the same event in different ways by adding an `<aura:handler>` tag to the sub component. The framework doesn't guarantee the order of event handling.

Helpers

A sub component's helper inherits the methods from the helper of its super component. A sub component can override a super component's helper method by defining a method with the same name as an inherited method.

Controllers

A sub component that extends a super component can call actions in the super component's client-side controller. For example, if the super component has an action called `doSomething`, the sub component can directly call the action using the `{ ! c.doSomething }` syntax.

 **Note:** We don't recommend using inheritance of client-side controllers as this feature may be deprecated in the future to preserve better component encapsulation. We recommend that you put common code in a helper instead.

SEE ALSO:

- [Component Attributes](#)
- [Communicating with Events](#)
- [Sharing JavaScript Code in a Component Bundle](#)
- [Handling Events with Client-Side Controllers](#)
- [aura:set](#)

Inherited Component Attributes

A sub component that extends a super component inherits the attributes of the super component.

Attribute values are identical at any level of extension. There is an exception to this rule for the `body` attribute, which we'll look at more closely soon.

Let's start with a simple example. `c:super` has a `description` attribute with a value of "Default description",

```
<!--c:super-->
<aura:component extensible="true">
    <aura:attribute name="description" type="String" default="Default description" />

    <p>super.cmp description: {!v.description}</p>

    { !v.body}
</aura:component>
```

Don't worry about the `{ !v.body}` expression for now. We'll explain that when we talk about the `body` attribute.

`c:sub` extends `c:super` by setting `extends="c:super"` in its `<aura:component>` tag.

```
<!--c:sub-->
<aura:component extends="c:super">
    <p>sub.cmp description: {!v.description}</p>
</aura:component>
```

Note that `sub.cmp` has access to the inherited `description` attribute and it has the same value in `sub.cmp` and `super.cmp`.

Use `<aura:set>` in the markup of a sub component to set the value of an inherited attribute.

Inherited `body` Attribute

Every component inherits the `body` attribute from `<aura:component>`. The inheritance behavior of `body` is different than other attributes. It can have different values at each level of component extension to enable different output from each component in the inheritance chain. This will be clearer when we look at an example.

Any free markup that is not enclosed in another tag is assumed to be part of the `body`. It's equivalent to wrapping that free markup inside `<aura:set attribute="body">`.

The default renderer for a component iterates through its `body` attribute, renders everything, and passes the rendered data to its super component. The super component can output the data passed to it by including `{ !v.body}` in its markup. If there is no super component, you've hit the root component and the data is inserted into `document.body`.

Let's look at a simple example to understand how the `body` attribute behaves at different levels of component extension. We have three components.

`c:superBody` is the super component. It inherently extends `<aura:component>`.

```
<!--c:superBody-->
<aura:component extensible="true">
    Parent body: {!v.body}
</aura:component>
```

At this point, `c:superBody` doesn't output anything for `{ !v.body}` as it's just a placeholder for data that will be passed in by a component that extends `c:superBody`.

`c:subBody` extends `c:superBody` by setting `extends="c:superBody"` in its `<aura:component>` tag.

```
<!--c:subBody-->
<aura:component extends="c:superBody">
    Child body: {!v.body}
</aura:component>
```

c:subBody outputs:

Parent body: Child body:

In other words, c:subBody sets the value for { !v.body } in its super component, c:superBody.

c:containerBody contains a reference to c:subBody.

```
<!--c:containerBody-->
<aura:component>
  <c:subBody>
    Body value
  </c:subBody>
</aura:component>
```

In c:containerBody, we set the body attribute of c:subBody to Body value. c:containerBody outputs:

Parent body: Child body: Body value

SEE ALSO:

[aura:set](#)

[Component Body](#)

[Component Markup](#)

Abstract Components

Object-oriented languages, such as Java, support the concept of an abstract class that provides a partial implementation for an object but leaves the remaining implementation to concrete sub-classes. An abstract class in Java can't be instantiated directly, but a non-abstract subclass can.

Similarly, the Aura Components programming model supports the concept of abstract components that have a partial implementation but leave the remaining implementation to concrete sub-components.

To use an abstract component, you must extend it and fill out the remaining implementation. An abstract component can't be used directly in markup.

The `<aura:component>` tag has a boolean `abstract` attribute. Set `abstract="true"` to make the component abstract.

SEE ALSO:

[Interfaces](#)

Interfaces

Interfaces define a component's shape by defining attributes, events, or methods that any implementing component contains. To use an interface, a component must implement it. An interface can't be used directly in markup.

An interface starts with the `<aura:interface>` tag, and can contain only these tags:

<aura:attribute>

This tag defines an attribute. An interface can have zero or more attributes.



Note: To set the value of an attribute inherited from an interface, redefine the attribute in the sub component using `<aura:attribute>` and set the value in its default attribute. When you extend a component, you can use `<aura:set>`

in a sub component to set the value of any attribute that's inherited from the super component. However, this usage of `<aura:set>` doesn't work for attributes inherited from an interface.

<aura:registerEvent>

This tag registers an event that can be fired by a component that implements the interface. There's no logic in the interface for firing the event. A component that implements the interface contains the code to fire the event.

<aura:method>

This tag defines a method as part of the API of a component that implements the interface. There's no logic for the method in the interface. A component that implements the interface contains the method logic.

You can't use markup, renderers, controllers, or anything else in an interface.

Implement an Interface

To implement an interface, set the `implements` system attribute in the `<aura:component>` tag to the name of the interface that you are implementing. For example:

```
<aura:component implements="mynamespace:myinterface" >
```

A component can implement an interface and extend another component.

```
<aura:component extends="ns1:cmp1" implements="ns2:intf1" >
```

An interface can extend multiple interfaces using a comma-separated list.

```
<aura:interface extends="ns:intf1,ns:int2" >
```

Since there are fewer restrictions on the content of abstract components, they are more common than interfaces. A component can implement multiple interfaces but can only extend one abstract component, so interfaces can be more useful for some design patterns.

Example

Here's an example of an interface.

```
<aura:interface>
    <aura:attribute name="value" type="String"/>

    <aura:registerEvent name="onItemSelected" type="ui:response"
        description="The event fired when the user selects an item" />

    <aura:method name="methodFromInterface">
        <aura:attribute name="stringAttribute" type="String" default="default string"/>
    </aura:method>
</aura:interface>
```

SEE ALSO:

[Setting Attributes Inherited from an Interface](#)

[Abstract Components](#)

Marker Interfaces

A marker interface is an empty interface with no attributes, events, or methods. A marker interface is used to enable specific usage for a component in an app.

For example, a component that implements the `force:appHostable` interface can be used as a custom tab in Lightning Experience or the Salesforce mobile app.

In JavaScript, you can determine if a component implements an interface by using `myCmp.isInstanceOf("myNamespace:myInterface")`.

SEE ALSO:

[Configure Components for Custom Tabs](#)

Inheritance Rules

This table describes the inheritance rules for various elements.

| Element | extends | implements | Default Base Element |
|------------------|---|---------------------|---------------------------------------|
| component | one extensible component | multiple interfaces | <code><aura:component></code> |
| app | one extensible app | N/A | <code><aura:application></code> |
| interface | multiple interfaces using a comma-separated list <code>(extends="ns:intf1,ns:int2")</code> | N/A | N/A |

SEE ALSO:

[Interfaces](#)

Best Practices for Conditional Markup

Using the `<aura:if>` tag is the preferred approach to conditionally display markup but there are alternatives. Consider the performance cost and code maintainability when you design components. The best design choice depends on your use case.

Conditionally Create Elements with `<aura:if>`

Let's look at a simple example that shows an error message when an error occurs.

```
<aura:if isTrue="={!v.isError}">
  <div>{!v.errorMessage}</div>
</aura:if>
```

The `<div>` component and its contents are only created and rendered if the value of the `isTrue` expression evaluates to `true`. If the value of the `isTrue` expression changes and evaluates to `false`, all the components inside the `<aura:if>` tag are destroyed. The components are created again if the `isTrue` expression changes again and evaluates to `true`.

The general guideline is to use `<aura:if>` because it helps your components load faster initially by deferring the creation and rendering of the enclosed element tree until the condition is fulfilled.

Toggle Visibility Using CSS

You can use CSS to toggle visibility of markup by calling `$A.util.toggleClass(cmp, 'class')` in JavaScript code.

Elements in markup are created and rendered up front, but they're hidden. For an example, see [Dynamically Showing or Hiding Markup](#).

The conditional markup is created and rendered even if it's not used, so `<aura:if>` is preferred.

Dynamically Create Components in JavaScript

You can dynamically create components in JavaScript code. However, writing code is usually harder to maintain and debug than using markup. Again, using `<aura:if>` is preferred but the best design choice depends on your use case.

SEE ALSO:

[Conditional Expressions](#)

[Dynamically Creating Components](#)

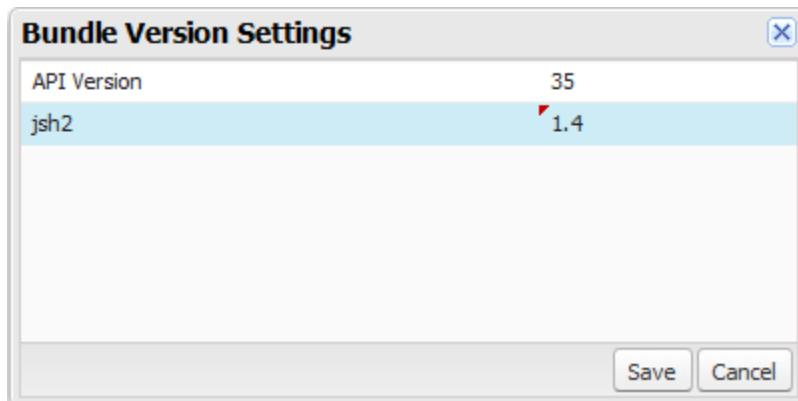
Aura Component Versioning

Aura component versioning enables you to declare dependencies against specific revisions of an installed managed package.

By assigning a version to your component, you have granular control over how the component functions when new versions of a managed package are released. For example, imagine that a `<packageNamespace>:button` is pinned to version 2.0 of a package. Upon installing version 3.0, the button retains its version 2.0 functionality.

 **Note:** The package developer is responsible for inserting versioning logic into the markup when updating a component. If the component wasn't changed in the update or if the markup doesn't account for version, the component behaves in the context of the most recent version.

Versions are assigned declaratively in the Developer Console. When you're working on a component, click **Bundle Version Settings** in the right panel to define the version. You can only version a component if you've installed a package, and the valid versions for the component are the available versions of that package. Versions are in the format `<major>. <minor>`. So if you assign a component version 1.4, its behavior depends on the first major release and fourth minor release of the associated package.



When working with components, you can version:

- Apex controllers
- JavaScript controllers
- JavaScript helpers
- JavaScript renderers
- Bundle markup

- Applications (.app)
- Components (.cmp)
- Interfaces (.intf)
- Events (.evt)

You can't version any other types of resources in bundles. Unsupported types include:

- Styles (.css)
- Documentation (.doc)
- Design (.design)
- SVG (.svg)

Once you've assigned versions to components, or if you're developing components for a package, you can retrieve the version in several contexts.

| Resource | Return Type | Expression |
|-----------------------|-------------|-------------------------|
| Apex | Version | System.requestVersion() |
| JavaScript | String | cmp.getVersion() |
| Aura component markup | String | {!Version} |

You can use the retrieved version to add logic to your code or markup to assign different functionality to different versions. Here's an example of using versioning in an `<aura:if>` statement.

```
<aura:component>
  <aura:if isTrue="{!!Version > 1.0}">
    <c:newVersionFunctionality/>
  </aura:if>
  <c:oldVersionFunctionality/>
  ...
</aura:component>
```

SEE ALSO:

[Components with Minimum API Version Requirements](#)

[Don't Mix Component API Versions](#)

Components with Minimum API Version Requirements

Some built-in components require that custom components that use them are set to a minimum API version. A custom component must be equal to or later than the latest API version required by any of the components it uses.

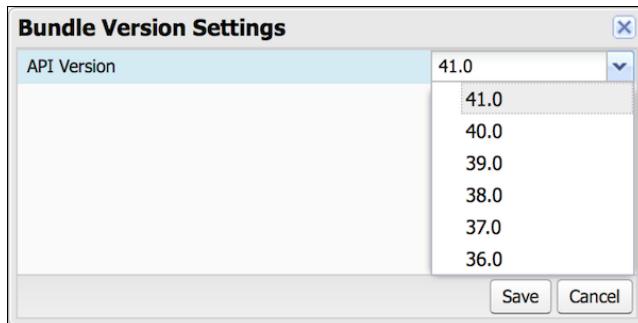
There are several different ways a custom component can use another component that has a minimum version requirement, and become subject to that requirement.

- The custom component can extend from the component with the minimum version requirement.
- The custom component can add another component as a child component in markup.
- The custom component can dynamically create and add a child component in JavaScript.

In cases where the relationship between components can be determined by static analysis, the version dependency is checked when the component is saved. If a custom component has an API version earlier than a minimum version required by any of the components used, an error is reported, and the component isn't saved. Depending on the tool you're using, this error is presented in different ways.

If a component is created dynamically, it isn't possible to determine the relationship between it and its parent component at save time. Instead, the minimum version requirement is checked at run time, and if it fails a run-time error is reported to the current user.

Set the API version for your component in the Developer Console, the Force.com IDE, or via API.



Versioning of Built-In Components

The minimum API version required to use a built-in component is listed on the component's reference page in the *Lightning Aura Components Developer Guide*. Components that don't specify a minimum API version are usable with any API version supported for Lightning components.

The minimum version for built-in components that are Generally Available (GA) won't increase in future releases. (However, as with Visualforce components, their behavior might change depending on the API version of the containing component.)

SEE ALSO:

- [Aura Component Versioning](#)
- [Don't Mix Component API Versions](#)

Validations for Aura Component Code

Validate your Aura component code to ensure compatibility with Aura component APIs, best practices, and avoidance of anti-patterns. There are several ways to validate your code. Minimal save-time validations catch the most significant issues only, while Salesforce DX tools provide more comprehensive static code analysis.

IN THIS SECTION:

[Validation When You Save Code Changes](#)

Aura component JavaScript code is validated when you save it. Validation ensures that your components are written using best practices and avoid common pitfalls that can make them incompatible with Lightning Locker. Validation happens automatically when you save Aura component resources in the Developer Console, in your favorite IDE, and via API.

[Validation During Development Using the Salesforce CLI](#)

Salesforce DX includes a code analysis and validation tool usable via the Salesforce CLI. Use `force:lightning:lint` to scan and improve your code during development. Validation using the Salesforce CLI doesn't just help you avoid Lightning Locker conflicts and anti-patterns. It's a terrific practice for improving your code quality and consistency, and to uncover subtle bugs before you commit them to your codebase.

[Review and Resolve Validation Errors and Warnings](#)

When you run validations on your Aura component code, the results include details for each issue found in the files scanned. Review the results and resolve problems in your code.

[Aura Component Validation Rules](#)

Rules built into Aura component code validations cover restrictions under Lightning Locker, correct use of Lightning APIs, and a number of best practices for writing Aura component code. Each rule, when triggered by your code, points to an area where your code might have an issue.

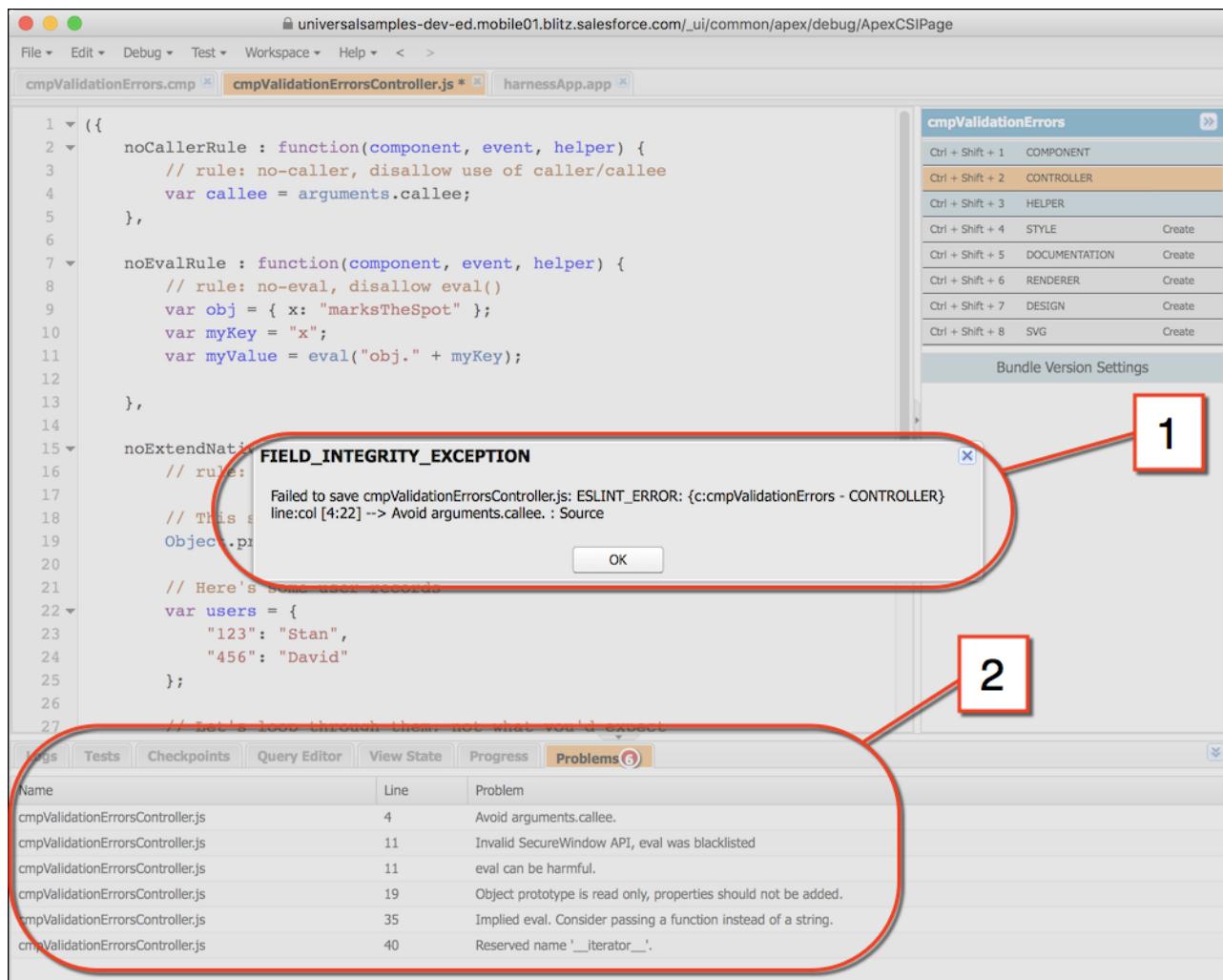
[Salesforce Lightning CLI \(Deprecated\)](#)

Lightning CLI was a Heroku Toolbelt plugin to scan your code for general JavaScript coding issues and Lightning-specific issues. Lightning CLI is deprecated in favor of the `force:lightning:lint` tool available in the Salesforce DX CLI.

Validation When You Save Code Changes

Aura component JavaScript code is validated when you save it. Validation ensures that your components are written using best practices and avoid common pitfalls that can make them incompatible with Lightning Locker. Validation happens automatically when you save Aura component resources in the Developer Console, in your favorite IDE, and via API.

Validation failures are treated as errors and block changes from being saved. Error messages explain the failures. Depending on the tool you're using, these errors are presented in different ways. For example, the Developer Console shows an alert for the first error it encounters (1), and lists all of the validation errors discovered in the **Problems** tab (2).



Validations are applied only to components set to API version 41.0 and later. If the validation service prevents you from saving important changes, set the component version to API 40.0 or earlier to disable validations temporarily. When you've corrected the coding errors, return your component to API 41.0 or later to save it with passing validations.

Validation During Development Using the Salesforce CLI

Salesforce DX includes a code analysis and validation tool usable via the Salesforce CLI. Use `force:lightning:lint` to scan and improve your code during development. Validation using the Salesforce CLI doesn't just help you avoid Lightning Locker conflicts and anti-patterns. It's a terrific practice for improving your code quality and consistency, and to uncover subtle bugs before you commit them to your codebase.

Validations using the Salesforce CLI are done separately from saving your code to Salesforce. The results are informational only. Validations performed by the Salesforce CLI fall into two categories, failures and warnings. Error messages explain both, and are displayed in your shell window. Here's some example output:

```
error      secure-document      Invalid SecureDocument API
Line:109:29
scraping = document.innerHTML;
^
```

```
warning  no-plusplus  Unary operator '++' used
Line:120:50
for (var i = (index+1); i < sibs.length; i++) {
^

error    secure-window  Invalid SecureWindow API
Line:33:21
var req = new XMLHttpRequest();
^

error  default-case  Expected a default case
Line:108:13
switch (e.keyCode) {
^
```

Validations performed using the Salesforce CLI are different from validations performed at save time in the following important ways.

- The Salesforce CLI uses many more rules to analyze your component code. Save time validations prevent you from making the most fundamental mistakes only. Validation with the Salesforce CLI errs on the side of giving you more information.
- Validation via the Salesforce CLI ignores the API version of your components. Save time validations are performed only for components set to API 41.0 and later.

IN THIS SECTION:

[Use force:lightning:lint](#)

Run `force:lightning:lint` just like any other lint command-line tool. The only trick is invoking it through the `sfdx` command. Your shell window shows the results.

[force:lightning:lint Options](#)

Use options to modify the behavior of `force:lightning:lint`.

[Custom "House Style" Rules](#)

Customize the JavaScript style rules that `force:lightning:lint` applies to your code.

Use `force:lightning:lint`

Run `force:lightning:lint` just like any other lint command-line tool. The only trick is invoking it through the `sfdx` command. Your shell window shows the results.

Normal Use

You can run the `force:lightning:lint` tool on any folder that contains Aura components:

```
sfdx force:lightning:lint ./path/to/lightning/components/
```



Note: `force:lightning:lint` runs only on local files. Use Salesforce DX or third-party tools to download your component code to your machine. Options include Salesforce CLI commands like `force:mdapi:retrieve` and `force:source:pull`, or other tools such as the Force.com IDE, the Ant Migration Tool, or various third-party options.

The default output only shows errors. To see warnings too, use the verbose mode option.

See “[Review and Resolve Validation Errors and Warnings](#)” for what to do with the output of running `force:lightning:lint`.

SEE ALSO:

[force:lightning:lint Options](#)

force:lightning:lint Options

Use options to modify the behavior of `force:lightning:lint`.

Common Options

Filtering Files

Sometimes, you just want to scan a particular kind of file. The `--files` argument allows you to set a pattern to match files against.

For example, the following command allows you to scan controllers only:

```
sfdx force:lightning:lint ./path/to/lightning/components/ --files **/*Controller.js
```

Verbose Mode

The default output shows only errors so you can focus on bigger issues. The `--verbose` argument allows you to see both warning messages and errors during the linting process.

For a complete list of command line parameters and how they affect tool behavior, see the [Salesforce CLI Command Reference](#).

`force:lightning:lint` has built-in help, which you can access with the following command:

```
sfdx force:lightning:lint --help
```

SEE ALSO:

[Use force:lightning:lint](#)

Custom “House Style” Rules

Customize the JavaScript style rules that `force:lightning:lint` applies to your code.

It’s common that different organizations or projects will adopt different JavaScript rules. Aura component validations help you work with Aura component APIs, not enforce Salesforce coding conventions. To that end, the validation rules are divided into two sets, *security* rules and *style* rules. The security rules can’t be modified, but you can modify or add to the style rules.

Use the `--config` argument to provide a custom rules configuration file. A custom rules configuration file allows you to define your own code style rules, which affect the **style** rules used by `force:lightning:lint`.

 **Note:** If failure of a custom rule generates a warning, the warning doesn’t appear in the default output. To see warnings, use the `--verbose` flag.

The default style rules are provided below. Copy the rules to a new file, and modify them to match your preferred style rules. Alternatively, you can use your existing ESLint rule configuration file directly. For example:

```
sfdx force:lightning:lint ./path/to/lightning/components/ --config ~/.eslintrc
```

 **Note:** Not all ESLint rules can be added or modified using `--config`. Only rules that we consider benign are usable. And again, you can’t override the security rules.

Default Style Rules

Here are the default style rules used by `force:lightning:lint`.

```
/*
 * Copyright (C) 2016 salesforce.com, inc.
 *
 * Licensed under the Apache License, Version 2.0 (the "License");
 * you may not use this file except in compliance with the License.
 * You may obtain a copy of the License at
 *
 *     http://www.apache.org/licenses/LICENSE-2.0
 *
 * Unless required by applicable law or agreed to in writing, software
 * distributed under the License is distributed on an "AS IS" BASIS,
 * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.
 * See the License for the specific language governing permissions and
 * limitations under the License.
 */

module.exports = {
  rules: {
    // code style rules, these are the default value, but the user can
    // customize them via --config in the linter by providing custom values
    // for each of these rules.
    "no-trailing-spaces": 1,
    "no-spaced-func": 1,
    "no-mixed-spaces-and-tabs": 0,
    "no-multi-spaces": 0,
    "no-multiple-empty-lines": 0,
    "no-lone-blocks": 1,
    "no-lonely-if": 1,
    "no-inline-comments": 0,
    "no-extra-parens": 0,
    "no-extra-semi": 1,
    "no-warning-comments": [0, { "terms": ["todo", "fixme", "xxx"], "location": "start"
  }],
    "block-scoped-var": 1,
    "brace-style": [1, "ltbs"],
    "camelcase": 1,
    "comma-dangle": [1, "never"],
    "comma-spacing": 1,
    "comma-style": 1,
    "complexity": [0, 11],
    "consistent-this": [0, "that"],
    "curly": [1, "all"],
    "eol-last": 0,
    "func-names": 0,
    "func-style": [0, "declaration"],
    "generator-star-spacing": 0,
    "indent": 0,
    "key-spacing": 0,
    "keyword-spacing": [0, "always"],
    "max-depth": [0, 4],
    "max-len": [0, 80, 4],
  }
}
```

```

    "max-nested-callbacks": [0, 2],
    "max-params": [0, 3],
    "max-statements": [0, 10],
    "new-cap": 0,
    "newline-after-var": 0,
    "one-var": [0, "never"],
    "operator-assignment": [0, "always"],
    "padded-blocks": 0,
    "quote-props": 0,
    "quotes": 0,
    "semi": 1,
    "semi-spacing": [0, {"before": false, "after": true}],
    "sort-vars": 0,
    "space-after-function-name": [0, "never"],
    "space-before-blocks": [0, "always"],
    "space-before-function-paren": [0, "always"],
    "space-before-function-parentheses": [0, "always"],
    "space-in-brackets": [0, "never"],
    "space-in-parens": [0, "never"],
    "space-infix-ops": 0,
    "space-unary-ops": [1, { "words": true, "nonwords": false }],
    "spaced-comment": [0, "always"],
    "vars-on-top": 0,
    "valid-jsdoc": 0,
    "wrap-regex": 0,
    "yoda": [1, "never"]
  }
};

}

```

Review and Resolve Validation Errors and Warnings

When you run validations on your Aura component code, the results include details for each issue found in the files scanned. Review the results and resolve problems in your code.

For example, here is some example output from the `force:lightning:lint` command.

```

error      secure-document  Invalid SecureDocument API
Line:109:29
scraping = document.innerHTML;
^

warning    no-plusplus   Unary operator '++' used
Line:120:50
for (var i = (index+1); i < sibs.length; i++) {
^

error      secure-window  Invalid SecureWindow API
Line:33:21
var req = new XMLHttpRequest();
^

error      default-case   Expected a default case
Line:108:13

```

```
switch (e.keyCode) {  
^
```

Results vary in appearance depending on the tool you use to run validations. However, the essential elements are the same for each issue found.

Issues are displayed, one for each warning or error. Each issue includes the line number, severity, and a brief description of the issue. It also includes the rule name, which you can use to look up a more detailed description of the issue. See “[Aura Component Validation Rules](#)” for the rules applied by Lightning code validations, as well as possible resolutions and options for further reading.

Your mission is to review each issue, examine the code in question, and to revise it to eliminate all of the genuine problems.

While no automated tool is perfect, we expect that most errors and warnings generated by Lightning code validations will point to genuine issues in your code, which you should plan to fix as soon as you can.

SEE ALSO:

[Aura Component Validation Rules](#)

Aura Component Validation Rules

Rules built into Aura component code validations cover restrictions under Lightning Locker, correct use of Lightning APIs, and a number of best practices for writing Aura component code. Each rule, when triggered by your code, points to an area where your code might have an issue.

In addition to the Lightning-specific rules we’ve created, other rules are active in Lightning validations, included from ESLint basic rules. Documentation for these rules is available on the ESLint project site. If you encounter an error or warning from a rule not described here, search for it on [the ESLint Rules page](#).

The set of rules used to validate your code varies depending on the tool you use, and the way you use it. Minimal save-time validations catch the most significant issues only, while Salesforce DX tools provide more comprehensive static code analysis.

IN THIS SECTION:

[Validation Rules Used at Save Time](#)

The following rules are used for validations that are done when you save your Aura component code.

[Validate JavaScript Intrinsic APIs \(ecma-intrinsics\)](#)

This rule deals with the intrinsic APIs in JavaScript, more formally known as ECMAScript.

[Validate Aura API \(aura-api\)](#)

This rule verifies that use of the framework APIs is according to the published documentation. The use of undocumented or private features is disallowed.

[Validate Aura Component Public API \(secure-component\)](#)

This rule validates that only public, supported framework API functions and properties are used.

[Validate Secure Document Public API \(secure-document\)](#)

This rule validates that only supported functions and properties of the `document` global are accessed.

[Validate Secure Window Public API \(secure-window\)](#)

This rule validates that only supported functions and properties of the `window` global are accessed.

[Disallow Use of caller and callee \(no-caller\)](#)

Prevent the use of `arguments.caller` and `argumentscallee`. These are also forbidden in ECMAScript 5 and later when in strict mode, which is enabled under Lightning Locker. This is a standard rule built into ESLint.

Disallow Script URLs (no-script-url)

Prevents the use of `javascript:` URLs. This is a standard rule built into ESLint.

Disallow Extending Native Objects (no-extend-native)

Prevent changing the behavior of built-in JavaScript objects, such as `Object` or `Array`, by modifying their prototypes. This is a standard rule built into ESLint.

Disallow Calling Global Object Properties as Functions (no-obj-calls)

Prevents calling the `Math`, `JSON`, and `Reflect` global objects as though they were functions. For example, `Math()` is disallowed. This follows the ECMAScript 5 specification. This is a standard rule built into ESLint.

Disallow Use of __iterator__ Property (no-iterator)

Prevents using the obsolete `__iterator__` property. Use standard JavaScript iterators and generators instead. This is a standard rule built into ESLint.

Disallow Use of __proto__ (no-proto)

Prevents using the obsolete `__proto__` property, which was deprecated in ECMAScript 3.1. Use `Object.getPrototypeOf()` instead. This is a standard rule built into ESLint.

Disallow with Statements (no-with)

Prevents using `with` statements, which adds members of an object to the current scope in a way that makes it hard to predict or view impact or behavior. This is a standard rule built into ESLint.

Validation Rules Used at Save Time

The following rules are used for validations that are done when you save your Aura component code.

Validation failures for any of these rules prevents saving changes to your code.

Lightning Platform Rules

These rules are specific to Aura component JavaScript code. These custom rules are written and maintained by Salesforce.

Validate Aura API (aura-api)

This rule verifies that use of the framework APIs is according to the published documentation. The use of undocumented or private features is disallowed.

Validate Secure Document Public API (secure-document)

This rule validates that only supported functions and properties of the `document` global are accessed.

Validate Secure Window Public API (secure-window)

This rule validates that only supported functions and properties of the `window` global are accessed.

General JavaScript Rules

These rules are general JavaScript rules, which enforce basic correct use of JavaScript required for Lightning components. These rules are built into the ESLint tool.

Disallow Use of caller and callee (no-caller)

Prevent the use of `arguments.caller` and `arguments.callee`. These are also forbidden in ECMAScript 5 and later when in strict mode, which is enabled under Lightning Locker.

Disallow Extending Native Objects (no-extend-native)

Prevent changing the behavior of built-in JavaScript objects, such as `Object` or `Array`, by modifying their prototypes.

Disallow Use of `__iterator__` Property (no-iterator)

Prevents using the obsolete `__iterator__` property. Use standard JavaScript iterators and generators instead.

Disallow Calling Global Object Properties as Functions (no-obj-calls)

Prevents calling the `Math`, `JSON`, and `Reflect` global objects as though they were functions. For example, `Math()` is disallowed. This follows the ECMAScript 5 specification.

Disallow Use of `__proto__` (no-proto)

Prevents using the obsolete `__proto__` property, which was deprecated in ECMAScript 3.1. Use `Object.getPrototypeOf()` instead.

Disallow Script URLs (no-script-url)

Prevents the use of `javascript:` URLs.

Disallow with Statements (no-with)

Prevents using `with` statements, which adds members of an object to the current scope in a way that makes it hard to predict or view impact or behavior.

Validate JavaScript Intrinsic APIs (`ecma-intrinsics`)

This rule deals with the intrinsic APIs in JavaScript, more formally known as ECMAScript.

When Lightning Locker is enabled, the framework prevents the use of unsupported API objects or calls. That means your Aura components code is allowed to use:

- Features built into JavaScript (“intrinsic” features)
- Published, supported features built into the Aura Components programming model.
- Published, supported features built into Lightning Locker `SecureObject` objects

What exactly are these “intrinsic APIs”? They’re the APIs defined in the [ECMAScript Language Specification](#). That is, things built into JavaScript. This includes Annex B of the specification, which deals with legacy browser features that aren’t part of the “core” of JavaScript, but are nevertheless still supported for JavaScript running inside a web browser.

Note that some features of JavaScript that you might consider intrinsic—for example, the `window` and `document` global variables—are superceded by `SecureObject` objects, which offer a more constrained API.

Rule Details

This rule verifies that use of the intrinsic JavaScript APIs is according to the published specification. The use of non-standard, deprecated, and removed language features is disallowed.

Further Reading

- [ECMAScript specification](#)
- [Annex B: Additional ECMAScript Features for Web Browsers](#)
- [Intrinsic Objects \(JavaScript\)](#)

SEE ALSO:

- [Validate Aura API \(aura-api\)](#)
- [Validate Aura Component Public API \(secure-component\)](#)
- [Validate Secure Document Public API \(secure-document\)](#)
- [Validate Secure Window Public API \(secure-window\)](#)

Validate Aura API (`aura-api`)

This rule verifies that use of the framework APIs is according to the published documentation. The use of undocumented or private features is disallowed.

When Lightning Locker is enabled, the framework prevents the use of unsupported API objects or calls. That means your Aura components code is allowed to use:

- Features built into JavaScript (“intrinsic” features)
- Published, supported features built into the Aura Components programming model.
- Published, supported features built into Lightning Locker *SecureObject* objects

This rule deals with the supported, public framework APIs, for example, those available through the framework global `$A`.

Why is this rule called “Aura API”? Because the core of the Aura Components programming model is the open source Aura Framework. And this rule verifies permitted uses of that framework, rather than anything specific to Lightning Components.

Rule Details

The following patterns are considered problematic:

```
Aura.something(); // Use $A instead  
$A.util.fake(); // fake is not available in $A.util
```

Further Reading

For details of all of the methods available in the framework, including `$A`, see the JavaScript API at <https://myDomain.lightning.force.com/auradocs/reference.app>, where *myDomain* is the name of your custom Salesforce domain.

SEE ALSO:

- [Validate Aura Component Public API \(`secure-component`\)](#)
- [Validate Secure Document Public API \(`secure-document`\)](#)
- [Validate Secure Window Public API \(`secure-window`\)](#)

Validate Aura Component Public API (`secure-component`)

This rule validates that only public, supported framework API functions and properties are used.

When Lightning Locker is enabled, the framework prevents the use of unsupported API objects or calls. That means your Aura components code is allowed to use:

- Features built into JavaScript (“intrinsic” features)
- Published, supported features built into the Aura Components programming model.
- Published, supported features built into Lightning Locker *SecureObject* objects

Prior to Lightning Locker, when you created or obtained a reference to a component, you could call any function and access any property available on that component, even if it wasn’t public. When Lightning Locker is enabled, components are “wrapped” by a new *SecureComponent* object, which controls access to the component and its functions and properties. *SecureComponent* restricts you to using only published, supported component API.

Rule Details

The reference doc app lists the API for `SecureComponent`. Access the reference doc app at:

`https://<myDomain>.lightning.force.com/auradocs/reference.app`, where `<myDomain>` is the name of your custom Salesforce domain.

The API for `SecureComponent` is listed at [JavaScript API > Component](#).

SEE ALSO:

- [Validate Aura API \(aura-api\)](#)
- [Validate Secure Document Public API \(secure-document\)](#)
- [Validate Secure Window Public API \(secure-window\)](#)

Validate Secure Document Public API (`secure-document`)

This rule validates that only supported functions and properties of the `document` global are accessed.

When Lightning Locker is enabled, the framework prevents the use of unsupported API objects or calls. That means your Aura components code is allowed to use:

- Features built into JavaScript (“intrinsic” features)
- Published, supported features built into the Aura Components programming model.
- Published, supported features built into Lightning Locker `SecureObject` objects

Prior to Lightning Locker, when you accessed the `document` global, you could call any function and access any property available. When Lightning Locker is enabled, the `document` global is “wrapped” by a new `SecureDocument` object, which controls access to `document` and its functions and properties. `SecureDocument` restricts you to using only “safe” features of the `document` global.

SEE ALSO:

- [Validate Aura API \(aura-api\)](#)
- [Validate Aura Component Public API \(secure-component\)](#)
- [Validate Secure Window Public API \(secure-window\)](#)

Validate Secure Window Public API (`secure-window`)

This rule validates that only supported functions and properties of the `window` global are accessed.

When Lightning Locker is enabled, the framework prevents the use of unsupported API objects or calls. That means your Aura components code is allowed to use:

- Features built into JavaScript (“intrinsic” features)
- Published, supported features built into the Aura Components programming model.
- Published, supported features built into Lightning Locker `SecureObject` objects

Prior to Lightning Locker, when you accessed the `window` global, you could call any function and access any property available. When Lightning Locker is enabled, the `window` global is “wrapped” by a new `SecureWindow` object, which controls access to `window` and its functions and properties. `SecureWindow` restricts you to using only “safe” features of the `window` global.

SEE ALSO:

- [Validate Aura API \(aura-api\)](#)
- [Validate Aura Component Public API \(secure-component\)](#)
- [Validate Secure Document Public API \(secure-document\)](#)

Disallow Use of `caller` and `callee` (`no-caller`)

Prevent the use of `arguments.caller` and `arguments.callee`. These are also forbidden in ECMAScript 5 and later when in strict mode, which is enabled under Lightning Locker. This is a standard rule built into ESLint.

For complete details about this rule, including examples, see the corresponding ESLint documentation, [Disallow Use of caller/callee \(no-caller\)](#).

Disallow Script URLs (`no-script-url`)

Prevents the use of `javascript:` URLs. This is a standard rule built into ESLint.

For complete details about this rule, including examples, see the corresponding ESLint documentation, [Disallow Script URLs \(no-script-url\)](#).

Disallow Extending Native Objects (`no-extend-native`)

Prevent changing the behavior of built-in JavaScript objects, such as `Object` or `Array`, by modifying their prototypes. This is a standard rule built into ESLint.

For complete details about this rule, including examples, see the corresponding ESLint documentation, [Disallow Extending of Native Objects \(no-extend-native\)](#).

Disallow Calling Global Object Properties as Functions (`no-obj-calls`)

Prevents calling the `Math`, `JSON`, and `Reflect` global objects as though they were functions. For example, `Math()` is disallowed. This follows the ECMAScript 5 specification. This is a standard rule built into ESLint.

For complete details about this rule, including examples, see the corresponding ESLint documentation, [Disallow calling global object properties as functions \(no-obj-calls\)](#).

Disallow Use of `__iterator__` Property (`no-iterator`)

Prevents using the obsolete `__iterator__` property. Use standard JavaScript iterators and generators instead. This is a standard rule built into ESLint.

For complete details about this rule, including examples, see the corresponding ESLint documentation, [Disallow Iterator \(no-iterator\)](#).

Disallow Use of `__proto__` (`no-proto`)

Prevents using the obsolete `__proto__` property, which was deprecated in ECMAScript 3.1. Use `Object.getPrototypeOf()` instead. This is a standard rule built into ESLint.

For complete details about this rule, including examples, see the corresponding ESLint documentation, [Disallow Use of __proto__ \(no-with\)](#).

Disallow `with` Statements (`no-with`)

Prevents using `with` statements, which adds members of an object to the current scope in a way that makes it hard to predict or view impact or behavior. This is a standard rule built into ESLint.

For complete details about this rule, including examples, see the corresponding ESLint documentation, [disallow with statements \(no-with\)](#).

Salesforce Lightning CLI (Deprecated)

Lightning CLI was a Heroku Toolbelt plugin to scan your code for general JavaScript coding issues and Lightning-specific issues. Lightning CLI is deprecated in favor of the `force:lightning:lint` tool available in the Salesforce DX CLI.

For more information about code validation using Salesforce DX, see the [Salesforce CLI Command Reference](#).

IN THIS SECTION:

[Install Salesforce Lightning CLI \(Deprecated\)](#)

Lightning CLI was a Heroku Toolbelt plugin to scan your code for general JavaScript coding issues and Lightning-specific issues. Lightning CLI is deprecated in favor of the `force:lightning:lint` tool available in the Salesforce DX CLI.

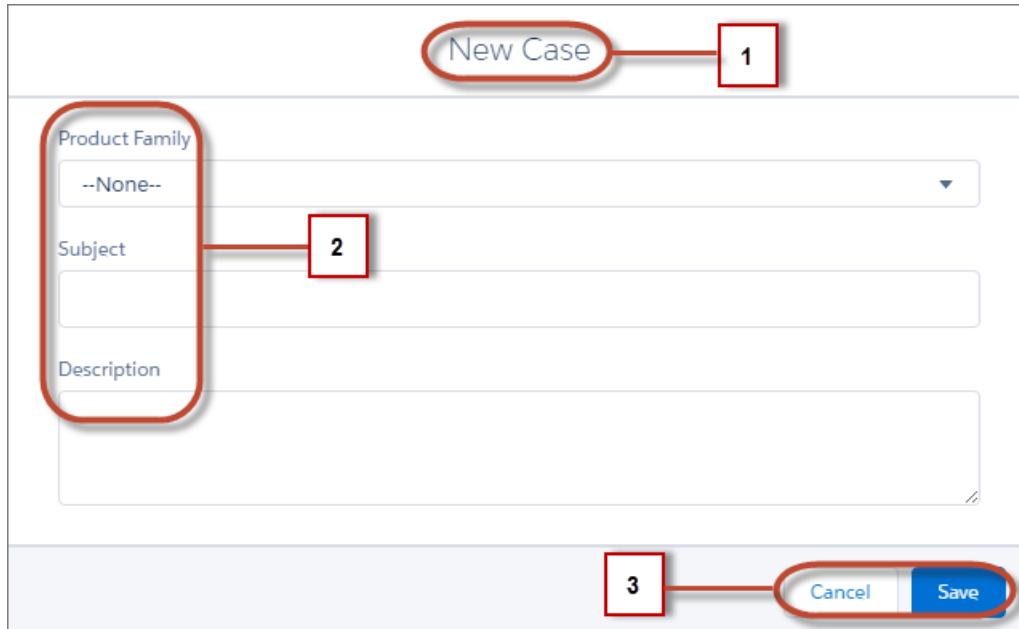
Install Salesforce Lightning CLI (Deprecated)

Lightning CLI was a Heroku Toolbelt plugin to scan your code for general JavaScript coding issues and Lightning-specific issues. Lightning CLI is deprecated in favor of the `force:lightning:lint` tool available in the Salesforce DX CLI.

For instructions on how to install the Salesforce DX CLI, see “[Install the Salesforce CLI](#)” in the [Salesforce DX Setup Guide](#).

Using Labels

Labels are text that presents information about the user interface, such as in the header (1), input fields (2), or buttons (3). While you can specify labels by providing text values in component markup, you can also access labels stored outside your code using the `$Label` global value provider in expression syntax.



This section discusses how to use the `$Label1` global value provider in these contexts:

- The `label1` attribute in input components
- The `format()` expression function for dynamically populating placeholder values in labels

IN THIS SECTION:

[Using Custom Labels](#)

Custom labels are custom text values that can be translated into any language that Salesforce supports. To access custom labels in Aura components, use the `$Label1` global value provider.

[Input Component Labels](#)

A label describes the purpose of an input component. To set a label on an input component, use the `label1` attribute.

[Dynamically Populating Label Parameters](#)

Output and update labels using the `format()` expression function.

[Getting Labels in JavaScript](#)

You can retrieve labels in JavaScript code. Your code performs optimally if the labels are statically defined and sent to the client when the component is loaded.

[Getting Labels in Apex](#)

You can retrieve label values in Apex code and set them on your component using JavaScript.

[Setting Label Values via a Parent Attribute](#)

Setting label values via a parent attribute is useful if you want control over labels in child components.

Using Custom Labels

Custom labels are custom text values that can be translated into any language that Salesforce supports. To access custom labels in Aura components, use the `$Label1` global value provider.

Custom labels enable developers to create multilingual applications by automatically presenting information (for example, help text or error messages) in a user's native language.

 **Note:** Label translations require the Translation Workbench is enabled.

To create custom labels, from Setup, enter *Custom Labels* in the Quick Find box, then select **Custom Labels**.

Use the following syntax to access custom labels in Aura components.

- `$Label.c.labelName` for the default namespace
- `$Label.namespace.labelName` if your org has a namespace, or to access a label in a managed package

You can reference custom labels in component markup and in JavaScript code. Here are some examples.

Label in a markup expression using the default namespace

```
{ !$Label.c.labelName }
```

 **Note:** Label expressions in markup are supported in .cmp and .app resources only.

Label in JavaScript code if your org has a namespace

```
$A.get("$Label.namespace.labelName")
```

 **Note:** Updates to a label locale or translation are not immediately in the application. To verify the change immediately, log out and in.

SEE ALSO:

[Value Providers](#)

Input Component Labels

A label describes the purpose of an input component. To set a label on an input component, use the `label` attribute.

This example shows how to use labels using the `label` attribute on an input component.

```
<lightning:input type="number" name="myNumber" label="Pick a Number:" value="54" />
```

The label is placed on the left of the input field and can be hidden by setting `variant="label-hidden"`, which applies the `slds-assistive-text` class to the label to support accessibility.

Using \$Label

Use the `$Label` global value provider to access labels stored in an external source. For example:

```
<lightning:input type="number" name="myNumber" label="{ !$Label.Number.PickOne }" />
```

To output a label and dynamically update it, use the `format()` expression function. For example, if you have `np.labelName` set to `Hello {0}`, the following expression returns `Hello World` if `v.name` is set to `World`.

```
{ !format($Label,np.labelName, v.name) }
```

SEE ALSO:

[Supporting Accessibility](#)

Dynamically Populating Label Parameters

Output and update labels using the `format()` expression function.

You can provide a string with placeholders, which are replaced by the substitution values at runtime.

Add as many parameters as you need. The parameters are numbered and are zero-based. For example, if you have three parameters, they will be named `{ 0 }`, `{ 1 }`, and `{ 2 }`, and they will be substituted in the order they're specified.

Let's look at a custom label, `$Label.mySection.myLabel`, with a value of `Hello { 0 } and { 1 }`, where `$Label` is the global value provider that accesses your labels.

This expression dynamically populates the placeholder parameters with the values of the supplied attributes.

```
{ !format($Label.mySection.myLabel, v.attribute1, v.attribute2) }
```

The label is automatically refreshed if one of the attribute values changes.



Note: Always use the `$Label` global value provider to reference a label with placeholder parameters. You can't set a string with placeholder parameters as the first argument for `format()`. For example, this syntax doesn't work:

```
{ !format('Hello { 0 }', v.name) }
```

Use this expression instead.

```
{ !format($Label.mySection.salutation, v.name) }
```

where `$Label.mySection.salutation` is set to `Hello { 0 }`.

Getting Labels in JavaScript

You can retrieve labels in JavaScript code. Your code performs optimally if the labels are statically defined and sent to the client when the component is loaded.

Static Labels

Static labels are defined in one string, such as `"$Label.c.task_mode_today"`. The framework parses static labels in markup or JavaScript code and sends the labels to the client when the component is loaded. A server trip isn't required to resolve the label.

Use `$A.get()` to retrieve static labels in JavaScript code. For example:

```
var staticLabel = $A.get("$Label.c.task_mode_today");
component.set("v.mylabel", staticLabel);
```

You can also retrieve label values using Apex code and send them to the component via JavaScript code. For more information, see [Getting Labels in Apex](#).

Dynamic Labels

`$A.get(labelReference)` must be able to resolve the label reference at compile time, so that the label values can be sent to the client along with the component definition.

If you must defer label resolution until runtime, you can dynamically create labels in JavaScript code. This technique can be useful when you need to use a label, but which specific label isn't known until runtime.

```
// Assume the day variable is dynamically generated
// earlier in the code
// THIS CODE WON'T WORK
var dynamicLabel = $A.get("$Label.c." + day);
```

If the label is already known on the client, `$A.get()` displays the label. If the value is not known, an empty string is displayed in production mode, or a placeholder value showing the label key is displayed in debug mode.

Using `$A.get()` with a label that can't be determined at runtime means that `dynamicLabel` is an empty string, and won't be updated to the retrieved value. Since the label, `"$Label.c." + day`, is dynamically generated, the framework can't parse it or send it to the client when the component is requested.

There are a few alternative approaches to using `$A.get()` so that you can work with dynamically generated labels.

If your component uses a known set of dynamically constructed labels, you can avoid a server roundtrip for the labels by adding a reference to the labels in a JavaScript resource. The framework sends these labels to the client when the component is requested. For example, if your component dynamically generates `$Label.c.task_mode_today` and `$Label.c.task_mode_tomorrow` label keys, you can add references to the labels in a comment in a JavaScript resource, such as a client-side controller or helper.

```
// hints to ensure labels are preloaded
// $Label.c.task_mode_today
// $Label.c.task_mode_tomorrow
```

If your code dynamically generates many labels, this approach doesn't scale well.

If you don't want to add comment hints for all the potential labels, the alternative is to use `$A.getReference()`. This approach comes with the added cost of a server trip to retrieve the label value.

This example dynamically constructs the label value by calling `$A.getReference()` and updates a `tempLabelAttr` component attribute with the retrieved label.

```
var labelSubStr = "task_mode_today";
var labelReference = $A.getReference("$Label.c." + labelSubStr);
cmp.set("v.tempLabelAttr", labelReference);
var dynamicLabel = cmp.get("v.tempLabelAttr");
```

`$A.getReference()` returns a reference to the label. This **isn't** a string, and you shouldn't treat it like one. You never get a string label directly back from `$A.getReference()`.

Instead, use the returned reference to set a component's attribute value. Our code does this in `cmp.set("v.tempLabelAttr", labelReference);`

When the label value is asynchronously returned from the server, the attribute value is automatically updated as it's a reference. The component is rerendered and the label value displays.



Note: Our code sets `dynamicLabel = cmp.get("v.tempLabelAttr")` immediately after getting the reference. This code displays an empty string until the label value is returned from the server. If you don't want that behavior, use a comment hint to ensure that the label is sent to the client without requiring a later server trip.

SEE ALSO:

- [Using JavaScript](#)
- [Input Component Labels](#)
- [Dynamically Populating Label Parameters](#)

Getting Labels in Apex

You can retrieve label values in Apex code and set them on your component using JavaScript.

Custom Labels

Custom labels have a limit of 1,000 characters and can be accessed from an Apex class. To define custom labels, from Setup, in the Quick Find box, enter *Custom Labels*, and then select **Custom Labels**.

In your Apex class, reference the label with the syntax `System.Label.MyLabelName`.

```
public with sharing class LabelController {
    @AuraEnabled
    public static String getLabel() {
        String s1 = 'Hello from Apex Controller, ' ;
        String s2 = System.Label.MyLabelName;
        return s1 + s2;
    }
}
```

 **Note:** Return label values as plain text strings. You can't return a label expression using the `$Label` global value provider.

The component loads the labels by requesting it from the server, such as during initialization. For example, the label is retrieved in JavaScript code.

```
({
    doInit : function(component, event, helper) {
        var action = component.get("c.getLabel");
        action.setCallback(this, function(response) {
            var state = response.getState();
            if (state === "SUCCESS") {
                component.set("v.mylabel", response.getReturnValue());
            }
            // error handling when state is "INCOMPLETE" or "ERROR"
        });
        $A.enqueueAction(action);
    }
})
```

Finally, make sure you wire up the Apex class to your component. The label is set on the component during initialization.

```
<aura:component controller="LabelController">
    <aura:handler name="init" value="{!this}" action=" {!c.doInit}" />
    <aura:attribute name="mylabel" type="String"/>
    {!v.mylabel}
</aura:component>
```

Passing in Label Values

Pass label values into components using the expression syntax `{!v.mylabel}`. You must provide a default value to the `String` attribute. Depending on your use case, the default value might be the label in the default language or, if the specific label can't be known until runtime, perhaps just a single space.

```
<aura:component controller="LabelController">
    <aura:attribute name="mylabel" type="String" default=" "/>
    <lightning:input name="mytext" label=" {!v.mylabel}"/>
</aura:component>
```

You can also retrieve labels in JavaScript code, including dynamically creating labels that are generated during runtime. For more information, see [Getting Labels in JavaScript](#).

Setting Label Values via a Parent Attribute

Setting label values via a parent attribute is useful if you want control over labels in child components.

Let's say that you have a container component, which contains another component, `inner.cmp`. You want to set a label value in `inner.cmp` via an attribute on the container component. This can be done by specifying the attribute type and default value. You must set a default value in the parent attribute if you are setting a label on an inner component, as shown in the following example.

This is the container component, which contains a default value `My Label` for the `_label` attribute.

```
<aura:component>
    <aura:attribute name="_label"
        type="String"
        default="My Label"/>
    <lightning:button label="Set Label" aura:id="button1" onclick="{!!c.setLabel}"/>
    <auradocs:inner aura:id="inner" label="{!!v._label}"/>
</aura:component>
```

This inner component contains a text area component and a `label` attribute that's set by the container component.

```
<aura:component>
    <aura:attribute name="label" type="String"/>
    <lightning:textarea aura:id="textarea"
        name="myTextarea"
        label="{!!v.label}"/>
</aura:component>
```

This client-side controller action updates the label value.

```
{
    setLabel:function(cmp) {
        cmp.set("v._label", 'new label');
    }
}
```

When the component is initialized, you'll see a button and a text area with the label `My Label`. When the button in the container component is clicked, the `setLabel` action updates the label value in the `inner` component. This action finds the `label` attribute and sets its value to `new label`.

SEE ALSO:

[Input Component Labels](#)
[Component Attributes](#)

Localization

The framework provides client-side localization support on input and output components.

The following example shows how you can override the default `timezone` attribute. The output displays the time in the format `hh:mm` by default.

```
<aura:component>
    <ui:outputDateTime value="2013-10-07T00:17:08.997Z" timezone="Europe/Berlin" />
</aura:component>
```

The component renders as `Oct 7, 2013 2:17:08 AM`.

To customize the date and time formatting, we recommend using `lightning:formattedDateTime`. This example sets the date and time using the `init` handler.

```
<aura:component>
    <aura:handler name="init" value="{!this}" action=" {!c.doInit}"/>
    <aura:attribute name="datetime" type="DateTime"/>
    <lightning:formattedDateTime value=" {!v.datetime}" timeZone="Europe/Berlin"
        year="numeric" month="short" day="2-digit" hour="2-digit"
        minute="2-digit" second="2-digit"/>
</aura:component>

({
    doInit : function(component, event, helper) {
        var date = new Date();
        component.set("v.datetime", date)
    }
})
```

This example creates a JavaScript Date instance, which is rendered in the format `MMM DD, YYYY HH:MM:SS AM`.

Although the output for this example is similar to `<ui:outputDateTime value=" {!v.datetime}" timeZone="Europe/Berlin" />`, the attributes on `lightning:formattedDateTime` enable you to control formatting at a granular level. For example, you can display the date using the `MM/DD/YYYY` format.

```
<lightning:formattedDateTime value=" {!v.datetime}" timeZone="Europe/Berlin" year="numeric"
    month="numeric" day="numeric"/>
```

Additionally, you can use the global value provider, `$Locale`, to obtain the locale information. The locale settings in your organization overrides the browser's locale information.

Working with Locale Information

In a single currency organization, Salesforce administrators set the currency locale, default language, default locale, and default time zone for their organizations. Users can set their individual language, locale, and time zone on their personal settings pages.

 **Note:** Single language organizations cannot change their language, although they can change their locale.

For example, setting the time zone on the Language & Time Zone page to `(GMT+02:00)` returns `28.09.2015 09:00:00` when you run the following code.

```
<ui:outputDateTime value="09/28/2015" />
```

Running `$A.get("$Locale.timezone")` returns the time zone name, for example, `Europe/Paris`. For more information, see "Supported Time Zones" in the Salesforce Help.

Setting the currency locale on the Company Information page to `Japanese (Japan) - JPY` returns `¥100,000` when you run the following code.

```
<ui:outputCurrency value="100000" />
```

 **Note:** To change between using the currency symbol, code, or name, use `lightning:formattedNumber` instead.

Similarly, running `$A.get("$Locale.currency")` returns "¥" when your org's currency locale is set to Japanese (Japan) – JPY. For more information, see "Supported Currencies" in the Salesforce Help.

SEE ALSO:

[Formatting Dates in JavaScript](#)

Providing Component Documentation

Component documentation helps others understand and use your components.

You can provide two types of component reference documentation:

- Documentation definition (DocDef): Full documentation on a component, including a description, sample code, and a reference to an example. DocDef supports extensive HTML markup and is useful for describing what a component is and what it does.
- Inline descriptions: Text-only descriptions, typically one or two sentences, set via the `description` attribute in a tag.

To provide a DocDef, click **DOCUMENTATION** in the component sidebar of the Developer Console. The following example shows the DocDef for `c:myComponent`.

 **Note:** DocDef is supported for components and applications. Events and interfaces support inline descriptions only.

```
<aura:documentation>
  <aura:description>
    <p>An <code>c:myComponent</code> component represents an element that executes an action defined by a controller.</p>
    <!--More markup here, such as <pre> for code samples-->
  </aura:description>
  <aura:example name="myComponentExample" ref="c:myComponentExample" label="Using the c:myComponent Component">
    <p>This example shows a simple setup of <code>myComponent</code>.</p>
  </aura:example>
  <aura:example name="mySecondExample" ref="c:mySecondExample" label="Customizing the c:myComponent Component">
    <p>This example shows how you can customize <code>myComponent</code>.</p>
  </aura:example>
</aura:documentation>
```

A documentation definition contains these tags.

| Tag | Description |
|---|---|
| <code><aura:documentation></code> | The top-level definition of the DocDef |
| <code><aura:description></code> | Describes the component using extensive HTML markup. To include code samples in the description, use the <code><pre></code> tag, which renders as a code block. Code entered in the <code><pre></code> tag must be escaped. For example, escape <code><aura:component></code> by entering <code>&lt;aura:component&gt;</code> . |
| <code><aura:example></code> | References an example that demonstrates how the component is used. Supports extensive HTML markup, which displays as text preceding the visual output and example component source. The example is displayed as interactive output. Multiple examples are supported and should be wrapped in individual <code><aura:example></code> tags. |

| Tag | Description |
|-----|--|
| | <ul style="list-style-type: none"> • <code>name</code>: The API name of the example • <code>ref</code>: The reference to the example component in the format <code><namespace:exampleComponent></code> • <code>label</code>: The label of the title |

Providing an Example Component

Recall that the DocDef includes a reference to an example component. The example component is rendered as an interactive demo in the component reference documentation when it's wired up using `aura:example`.

```
<aura:example name="myComponentExample" ref="c:myComponentExample" label="Using the c:myComponent Component">
```

The following is an example component that demonstrates how `c:myComponent` can be used.

```
<!--The c:myComponentExample example component-->
<aura:component>
    <c:myComponent>
        <aura:set attribute="myAttribute">This sets the attribute on the c:myComponent component.</aura:set>
        <!--More markup that demonstrates the usage of c:myComponent-->
    </c:myComponent>
</aura:component>
```

Supported HTML Tags in Document Definitions

Some HTML tags are unsafe or unnecessary. The framework doesn't support these tags in document definitions.

The `SUPPORTED_HTML_TAGS` key in [this open-source Aura file](#) lists the supported HTML tags. The `SUPPORTED_ATTRS` key lists the supported HTML tag attributes.



Note: The linked file is in the master branch of the open-source Aura project. The master branch is our current development branch and is ahead of the current release of the Aura Components programming model. However, this file changes infrequently and is the best place to see if a tag is supported now or in the near future.

Providing Inline Descriptions

Inline descriptions provide a brief overview of what an element is about. HTML markup is not supported in inline descriptions. These tags support inline descriptions via the `description` attribute.

| Tag | Example |
|-------------------------------------|--|
| <code><aura:component></code> | <code><aura:component description="Represents a button element"></code> |
| <code><aura:attribute></code> | <code><aura:attribute name="label" type="String" description="The text to be displayed inside the button." /></code> |

| Tag | Example |
|----------------------|--|
| <aura:event> | <aura:event type="COMPONENT" description="Indicates that a keyboard key has been pressed and released"/> |
| <aura:interface> | <aura:interface description="A common interface for date components"/> |
| <aura:registerEvent> | <aura:registerEvent name="keydown" type="ui:keydown" description="Indicates that a key is pressed"/> |

Viewing the Documentation

The documentation you create will be available in the [Component Library](#).

SEE ALSO:

[Reference](#)

Working with Base Lightning Components

Base Lightning components are the building blocks that make up the modern Lightning Experience, Salesforce app, and Lightning Communities user interfaces.

Base Lightning components incorporate Lightning Design System markup and classes, providing improved performance and accessibility with a minimum footprint.

These base components handle the details of HTML and CSS for you. Each component provides simple attributes that enable variations in style. This means that you typically don't need to use CSS at all. The simplicity of the base Lightning component attributes and their clean and consistent definitions make them easy to use, enabling you to focus on your business logic.

You can find base Lightning components in the `lightning` namespace to complement the existing `ui` namespace components. In instances where there are matching `ui` and `lightning` namespace components, we recommend that you use the `lightning` namespace component. The `lightning` namespace components are optimized for common use cases. Beyond being equipped with the Lightning Design System styling, they handle accessibility, real-time interaction, and enhanced error messages.

In subsequent releases, we intend to provide additional base Lightning components. We expect that in time the `lightning` namespace will have parity with the `ui` namespace and go beyond it. In addition, the base Lightning components will evolve with the Lightning Design System over time. This ensures that your customizations continue to match Lightning Experience and the Salesforce app.

While the base components are visual building blocks and provides minimum functionality out-of-the-box, they can be combined together to build “experience components” with richer capabilities and made accessible via the Lightning App Builder. Admins can drag-and-drop these experience components to build and configure user interfaces easily. For example, the Chatter Feed component in Lightning App Builder comprises a collection of tabs, a group of buttons, and a rich text editor.

The API version column denotes the minimum API version you must set to use the component in the Developer Console, the Force.com IDE, or via API. Components that don't specify a minimum API version are usable with any API version 37.0 and later.



Note: Interactive examples for the following components are available in the [Component Library](#).

Buttons

These components provide different button flavors.

| Type | Lightning Component Name | Description | Lightning Design System | API Version |
|------------------------|---|--|---------------------------------|-------------|
| Button | <code>lightning:button</code> | Represents a button element. | Buttons | |
| Button Group | <code>lightning:buttonGroup</code> | Represents a group of buttons. | Button Groups | |
| Button Icon | <code>lightning:buttonIcon</code> | An icon-only HTML button. | Button Icons | |
| Button Icon (Stateful) | <code>lightning:buttonIconStateful</code> | An icon-only button that retains state. | Button Icons | 41.0 |
| Button Menu | <code>lightning:buttonMenu</code> | A dropdown menu with a list of actions or functions. | Menus | |
| | <code>lightning:menuItem</code> | A list item in <code>lightning:buttonMenu</code> . | | |
| | <code>lightning:menuDivider</code> | A horizontal line separating menu items in <code>lightning:buttonMenu</code> . | | |
| | <code>lightning:menuSubheader</code> | A subheading for menu items in <code>lightning:buttonMenu</code> . | | |
| Button Stateful | <code>lightning:buttonStateful</code> | A button that toggles between states. | Button Stateful | |
| Insert Image Button | <code>lightning:insertImageButton</code> | A button for inserting images in <code>lightning:inputRichText</code> . | Button Icons | 43.0 |

Data Entry

Use these components for data entry.

| Type | Lightning Component Name | Description | Lightning Design System | API Version |
|----------------|--------------------------------------|--|----------------------------------|-------------|
| Address | <code>lightning:inputAddress</code> | Represents an address compound field. | Form Layout | 42.0 |
| Checkbox Group | <code>lightning:checkboxGroup</code> | Enables single or multiple selection on a group of options. | Checkbox | 41.0 |
| Combobox | <code>lightning:combobox</code> | An input element that enables single selection from a list of options. | Combobox | |
| Dual Listbox | <code>lightning:dualListbox</code> | Provides an input listbox accompanied with a listbox of | Dueling Picklist | 41.0 |

| Type | Lightning Component Name | Description | Lightning Design System | API Version |
|------------------------------|--------------------------|---|------------------------------------|-------------|
| | | selectable options. Options can be moved between the two lists. | | |
| File Uploader and Preview | lightning:fileUpload | Enables file uploads to a record. | File Selector | 41.0 |
| | lightning:fileCard | Displays a representation of uploaded content. | Files | |
| Input | lightning:input | Represents interactive controls that accept user input depending on the type attribute. | Input | |
| Input Field | lightning:inputField | Represents an editable input for a field on a Salesforce object. | Form Layout | 42.0 |
| Input Name | lightning:inputName | Represents a name compound field. | Form Layout | 42.0 |
| Input Location (Geolocation) | lightning:inputLocation | A geolocation compound field that accepts a latitude and longitude value. | Form Layout | 41.0 |
| Radio Group | lightning:radioGroup | Enables single selection on a group of options. | Radio Button Radio Button Group | 41.0 |
| Select | lightning:select | Creates an HTML select element. | Select | |
| Slider | lightning:slider | An input range slider for specifying a value between two specified numbers. | Slider | 41.0 |
| Rich Text Area | lightning:inputRichText | A WYSIWYG editor with a customizable toolbar for entering rich text. | Rich Text Editor | |
| Text Area | lightning:textArea | A multiline text input. | Textarea | |

Displaying Data

Use these components to display data.

| Type | Lightning Component Name | Description | Lightning Design System | API Version |
|---------------|-----------------------------|---|-------------------------|-------------|
| Address | lightning:formattedAddress | Displays a formatted address that provides a link to the given location on Google Maps. | N/A | 42.0 |
| Click-to-dial | lightning:clickToDial | | | |
| Date/Time | lightning:formattedDateTime | Displays formatted date and time. | | |

| Type | Lightning Component Name | Description | Lightning Design System | API Version |
|--------------------|--|--|-------------------------|-------------|
| Email | <code>lightning:formattedEmail</code> | Displays an email as a hyperlink with the <code>mailto:</code> URL scheme. | | 41.0 |
| Geolocation | <code>lightning:formattedLocation</code> | Displays a geolocation using the format <code>latitude,</code> <code>longitude.</code> | | 41.0 |
| Name | <code>lightning:formattedName</code> | Displays a formatted name that can include a salutation and suffix. | | 42.0 |
| Number | <code>lightning:formattedNumber</code> | Displays formatted numbers. | | |
| Output Field | <code>lightning:outputField</code> | Displays a label, help text, and value for a field on a Salesforce object. | | 41.0 |
| Phone | <code>lightning:formattedPhone</code> | Displays a phone number as a hyperlink with the <code>tel:</code> URL scheme. | | 41.0 |
| Rich Text | <code>lightning:formattedRichText</code> | Displays rich text that's formatted with whitelisted tags and attributes. | | 41.0 |
| Text | <code>lightning:formattedText</code> | Displays text, replaces newlines with line breaks, and linkifies if requested. | | 41.0 |
| Time | <code>lightning:formattedTime</code> | Displays a formatted time based on the user's locale. | | 42.0 |
| URL | <code>lightning:formattedUrl</code> | Displays a URL as a hyperlink. | | 41.0 |
| Relative Date/Time | <code>lightning:relativeDateTime</code> | Displays the relative time difference between the source date-time and the provided date-time. | | |

Forms

use these components to edit and view records

| Type | Lightning Component Name | Description | Lightning Design System | API Version |
|------------------|---------------------------------------|--|-----------------------------|-------------|
| Record Edit Form | <code>lightning:recordEditForm</code> | A grouping of <code>lightning:inputField</code> components of record fields to be edited in a form. | Form Layout | 42.0 |
| Record Form | <code>lightning:recordForm</code> | A container to simplify form creation for viewing and editing record fields. | Form Layout | 43.0 |
| Record View Form | <code>lightning:recordViewForm</code> | A grouping of <code>lightning:outputField</code> components and other formatted display components to display record fields in a form. | Form Layout | 42.0 |

Layout

The following components group related information together.

| Type | Lightning Component Name | Description | Lightning Design System | API Version |
|-----------|----------------------------|--|-------------------------|-------------|
| Accordion | lightning:accordion | A collection of vertically stacked sections with multiple content areas. | Accordion | 41.0 |
| | lightning:accordionSection | A single section that is nested in a lightning:accordion component. | | |
| Card | lightning:card | Applies a container around a related grouping of information. | Cards | |
| Carousel | lightning:carousel | A collection of images that are displayed horizontally one at a time. | Carousel | 42.0 |
| Layout | lightning:layout | Responsive grid system for arranging containers on a page. | Grid | |
| | lightning:layoutItem | A container within a lightning:layout component. | | |
| Tabs | lightning:tab | A single tab that is nested in a lightning:tabset component. | Tabs | |
| | lightning:tabset | Represents a list of tabs. | | |
| Tile | lightning:tile | A grouping of related information associated with a record. | Tiles | |

Navigation Components

The following components organize links and actions in a hierarchy or to visit other locations in an app.

| Type | Lightning Component Name | Description | Lightning Design System | API Version |
|---------------------|------------------------------|--|-------------------------|-------------|
| Breadcrumb | lightning:breadcrumb | An item in the hierarchy path of the page the user is on. | Breadcrumbs | |
| | lightning:breadcrumbs | A hierarchy path of the page you're currently visiting within the website or app. | | |
| Navigation | lightning:navigation | Generates a URL for a page reference. | N/A | 43.0 |
| Map | lightning:map | Displays a map of one or more locations | Map | 44.0 |
| Tree | lightning:tree | Displays a structural hierarchy with nested items. | Trees | 41.0 |
| Vertical Navigation | lightning:verticalNavigation | A vertical list of links that take you to another page or parts of the page you're in. | Vertical Navigation | 41.0 |

| Type | Lightning Component Name | Description | Lightning Design System | API Version |
|------|--|---|-------------------------|-------------|
| | <code>lightning:verticalNavigationItem</code> | A text-only link within <code>lightning:verticalNavigationSection</code> or <code>lightning:verticalNavigationOverflow</code> | | |
| | <code>lightning:verticalNavigationItemWithBadge</code> | A link and badge within <code>lightning:verticalNavigationSection</code> or <code>lightning:verticalNavigationOverflow</code> | | |
| | <code>lightning:verticalNavigationItemIcon</code> | A link and icon within <code>lightning:verticalNavigationSection</code> or <code>lightning:verticalNavigationOverflow</code> | | |
| | <code>lightning:verticalNavigationOverflow</code> | An overflow of items in <code>lightning:verticalNavigation</code> | | |
| | <code>lightning:verticalNavigationSection</code> | A section within <code>lightning:verticalNavigation</code> | | |

Visual Components

The following components provide informative cues, for example, like icons and loading spinners.

| Type | Lightning Component Name | Description | Lightning Design System | API Version |
|---------------------|---|---|-------------------------------|-------------|
| Avatar | <code>lightning:avatar</code> | A visual representation of an object. | Avatars | |
| Badge | <code>lightning:badge</code> | A label that holds a small amount of information. | Badges | |
| Data Table | <code>lightning:datatable</code> | A table that displays columns of data, formatted according to type. | Data Tables | 41.0 |
| Dynamic Icon | <code>lightning:dynamicIcon</code> | A variety of animated icons. | Dynamic Icons | 41.0 |
| Help Text (Tooltip) | <code>lightning:helptext</code> | An icon with a popover container a small amount of text. | Tooltips | |
| Icon | <code>lightning:icon</code> | A visual element that provides context. | Icons | |
| List View | <code>lightning:listView</code> | Displays a list view of the specified object | N/A | 42.0 |
| Messaging | <code>lightning:overlayLibrary</code> | Displays messages via modals and popovers. | Messaging | 41.0 |
| | <code>lightning:notificationsLibrary</code> | Displays messages via notices and toasts. | Messaging | 41.0 |

| Type | Lightning Component Name | Description | Lightning Design System | API Version |
|-----------------------------|-----------------------------|---|-----------------------------|-------------|
| Path | lightning:path | Displays a path driven by a picklist field and Path Setup metadata. | Path | 41.0 |
| Picklist Path | lightning:picklistPath | Displays a path based on a specified picklist field. | | |
| Pill | lightning:pill | A pill represents an existing item in a database, as opposed to user-generated freeform text. | Pills | |
| Pill Container | lightning:pillContainer | A list of pills grouped in a container. | Pills | 42.0 |
| Progress Bar | lightning:progressBar | A horizontal progress bar from left to right to indicate the progress of an operation. | Progress Bars | 41.0 |
| Progress Indicator and Path | lightning:progressIndicator | Displays steps in a process to indicate what has been completed. | Progress Indicators Path | 41.0 |
| Tree Grid | lightning:treeGrid | A hierarchical view of data presented in a table. | Trees | 42.0 |
| Spinner | lightning:spinner | Displays an animated spinner. | Spinners | |

Feature-Specific Components

The following components are usable only in the context of specific Salesforce features.

| Type | Lightning Component Name | Description | Lightning Design System | API Version |
|-------------------------------|------------------------------|---|-------------------------|-------------|
| Lightning Page Region | lightning:flexPageRegionInfo | Provides Lightning page region information to the component that contains it. | N/A | 41.0 |
| Flow Interview | lightning:flow | Represents a flow interview in Lightning runtime. | | 41.0 |
| Omni-Channel Toolkit | lightning:omniToolkitAPI | Provides API access to methods for the Omni-channel toolkit. | | 41.0 |
| Lightning Console Utility Bar | lightning:utilityBarAPI | Provides API access to methods for the utility bar in Lightning Console. | | 41.0 |
| Lightning Console Workspace | lightning:workspaceAPI | Provides API access to methods for the workspace in Lightning Console. | | 41.0 |

| Type | Lightning Component Name | Description | Lightning Design System | API Version |
|---------------|---|--|-------------------------|-------------|
| Snap-ins Chat | <code>lightningsnipin:prechatAPI</code> | Enables customization of the user interface for the pre-chat page. | | 42.0 |
| Snap-ins Chat | <code>lightningsnipin:settingsAPI</code> | Provides API access to Snap-ins settings within your custom Snap-ins components. | | 43.0 |
| Snap-ins Chat | <code>lightningsnipin:minimizedAPI</code> | Enables customization of the user interface for the minimized snap-in for Snap-ins Chat. | | 43.0 |

Base Lightning Components Considerations

Learn about the guidelines on using the base Lightning components.



Warning: Don't depend on the markup of a Lightning component as its internals can change in future releases. Reaching into the component internals can also cause unrecoverable errors in the app. For example, using `cmp.get("v.body")` and examining the DOM elements can cause issues in your code if the component markup changes down the road.

With Lightning Locker enforced, you can't traverse the DOM for components you don't own. Instead of accessing the DOM tree, take advantage of value binding with component attributes and use component methods that are available to you. For example, to get an attribute on a component, use `cmp.find("myInput").get("v.name")` instead of `cmp.find("myInput").getElement().name`. The latter doesn't work if you don't have access to the component, such as a component in another namespace.

Many of the base Lightning components are still evolving and the following considerations can help you while you're building your apps.

lightning:buttonMenu

This component contains menu items that are created only if the button is triggered. You can't reference the menu items during initialization or if the button isn't triggered yet.

lightning:input

Fields for percentage and currency input must specify a step increment of 0.01 as required by the native implementation.

```
<lightning:input type="number" name="percentVal" label="Enter a percentage value"
formatter="percent" step="0.01" />
<lightning:input type="number" name="currencyVal" label="Enter a dollar amount"
formatter="currency" step="0.01" />
```

When working with checkboxes, radio buttons, and toggle switches, use `aura:id` to group and traverse the array of components. Grouping them enables you to use `get("v.checked")` to determine which elements are checked or unchecked without reaching into the DOM. You can also use the `name` and `value` attributes to identify each component during the iteration. The following example groups three checkboxes together using `aura:id`.

```
<aura:component>
  <form>
    <fieldset>
      <legend>Select your favorite color:</legend>
      <lightning:input type="checkbox" label="Red"
        name="color1" value="1" aura:id="colors"/>
```

```

<lightning:input type="checkbox" label="Blue"
    name="color2" value="2" aura:id="colors"/>
<lightning:input type="checkbox" label="Green"
    name="color3" value="3" aura:id="colors"/>
</fieldset>
<lightning:button label="Submit" onclick="{!!c.submitForm}" />
</form>
</aura:component>

```

In your client-side controller, you can retrieve the array using `cmp.find("colors")` and inspect the `checked` values.

When working with `type="file"`, you must provide your own server-side logic for uploading files to Salesforce. Read the file using the `FileReader` HTML object, and then encode the file contents before sending them to your Apex controller. In your Apex controller, you can use the `EncodingUtil` methods to decode the file data. For example, you can use the `Attachment` object to upload files to a parent object. In this case, you pass in the base64 encoded file to the `Body` field to save the file as an attachment in your Apex controller.

Uploading files using this component is subject to regular Apex controller limits, which is 1 MB. To accommodate file size increase due to base64 encoding, we recommend that you set the maximum file size to 750 KB. You must implement chunking for file size larger than 1 MB. Files uploaded via chunking are subject to a size limit of 4 MB. For more information, see the [Apex Developer Guide](#). Alternatively, you can use `lightning:fileUpload` to upload files directly to records.

lightning:tab (Beta)

This component creates its body during runtime. You can't reference the component during initialization. Referencing the component using `aura:id` can return unexpected results, such as the component returning an undefined value when implementing `cmp.find("myComponent")`.

lightning:tabset (Beta)

When you load more tabs than can fit the width of the viewport, the tabset provides navigation buttons that scrolls horizontally to display the overflow tabs.

Methods with Limited Support on Some Components

Some methods have limited support or no support on these components:

- `lightning:avatar`
- `lightning:badge`
- `lightning:breadcrumb`
- `lightning:formattedDateTime`
- `lightning:formattedNumber`
- `lightning:icon`
- `lightning:input`
- `lightning:inputField`
- `lightning:outputField`
- `lightning:relativeDateTime`
- `lightning:textarea`

getDef()

`getDef()` can't get API methods or attach change handlers in the specified components. The correct way to work with base Lightning components is to work with the instances, and not attempt to access the component or its definition.

getReference()

`getReference()` method support is limited. You can't use it with controllers with these components. For example, `getReference('v.value')` works but `getReference('c.myFunc')` doesn't work.

afterRender()

`afterRender()` isn't supported by the specified components. You shouldn't call `afterRender()` on Lightning base components directly. For example, `component.find('lightning:input').afterRender()` doesn't work.

No nested component access

You can't access sub-components inside a base Lightning component. You can only use the exposed API. For example, `cmp.find('mylightning:inputField').find('innercomponent')` doesn't work.

Event Handling in Base Lightning Components

Base components are lightweight and closely resemble HTML markup. They follow standard HTML practices by providing event handlers as attributes, such as `onfocus`, instead of registering and firing Lightning component events, like components in the `ui` namespace.

Because of their markup, you might expect to access DOM elements for base components via `event.target` or `event.currentTarget`. However, this type of access breaks encapsulation because it provides access to another component's DOM elements, which are subject to change.

Lightning Locker enforces encapsulation. Use the methods described here to make your code compliant with Lightning Locker.

To retrieve the component that fired the event, use `event.getSource()`.

```
<aura:component>
    <lightning:button name="myButton" onclick="{!!c.doSomething}" />
</aura:component>
```

```
{
    doSomething: function(cmp, event, helper) {
        var button = event.getSource();

        //The following patterns are not supported
        //when you're trying to access another component's
        //DOM elements.
        var el = event.target;
        var currentEl = event.currentTarget;
    }
})
```

 **Note:** For events fired by standard HTML elements, you can use `event.currentTarget` and `event.target`. For events fired by base Lightning components, use `event.getSource()` instead.

Retrieve a component attribute that's passed to the event by using this syntax.

```
event.getSource().get("v.name")
```

Reusing Event Handlers

`event.getSource()` helps you determine which component fired an event. Let's say you have several buttons that reuse the same `onclick` handler. To retrieve the name of the button that fired the event, use `event.getSource().get("v.name")`.

```
<aura:component>
    <lightning:button label="New Record" name="new" onclick="{!!c.handleClick}" />
```

```
<lightning:button label="Edit" name="edit" onclick="{!!c.handleClick}"/>
<lightning:button label="Delete" name="delete" onclick="{!!c.handleClick}"/>
</aura:component>

({
  handleClick: function(cmp, event, helper) {
    //returns "new", "edit", or "delete"
    var buttonName = event.getSource().get("v.name");
  }
})
```

Retrieving the Active Component Using the `onactive` Handler

When working with tabs, you want to know which one is active. The `lightning:tab` component enables you to obtain a reference to the target component when it becomes active using the `onactive` handler. Clicking the component multiple times invokes the handler once only.

```
<aura:component>
  <lightning:tabset>
    <lightning:tab onactive="{!! c.handleActive }" label="Tab 1" id="tab1" />
    <lightning:tab onactive="{!! c.handleActive }" label="Tab 2" id="tab2" />
  </lightning:tabset>
</aura:component>

({
  handleActive: function (cmp, event) {
    var tab = event.getSource();
    switch (tab.get('v.id')) {
      case 'tab1':
        //do something when tab1 is clicked
        break;
      case 'tab2':
        //do something when tab2 is clicked
        break;
    }
  }
})
```

Retrieving the ID and Value Using the `onselect` Handler

Some components provide event handlers to pass in events to child components, such as the `onselect` event handler on the following components.

- `lightning:buttonMenu`
- `lightning:tabset`

Although the `event.detail` syntax continues to be supported, we recommend that you update your JavaScript code to use the following patterns for the `onselect` handler as we plan to deprecate `event.detail` in a future release.

- `event.getParam("id")`
- `event.getParam("value")`

For example, you want to retrieve the value of a selected menu item in a `lightning:buttonMenu` component from a client-side controller.

```
//Before
var menuItem = event.detail.menuItem;
var itemValue = menuItem.get("v.value");
//After
var itemValue = event.getParam("value");
```

Similarly, to retrieve the ID of a selected tab in a `lightning:tabset` component:

```
//Before
var tab = event.detail.selectedTab;
var tabId = tab.get("v.id");
//After
var tabId = event.getParam("id");
```

 **Note:** If you need a reference to the target component, use the `onactive` event handler instead.

Lightning Design System Considerations

Although the base Lightning components provide Salesforce Lightning Design System styling out-of-the-box, you may still want to write some CSS depending on your requirements.

If you're using the components outside of the Salesforce app and Lightning Experience, such as in standalone apps and Lightning Out, extend `force:slds` to apply Lightning Design System styling to your components. Here are several guidelines for using Lightning Design System in base components.

Using Utility Classes in Base Components

Lightning Design System utility classes are the fundamentals of your component's visual design and promote reusability, such as for alignments, grid, spacing, and typography. Most base components provide a `class` attribute, so you can add a utility class or custom class to the outer element of the components. For example, you can apply a spacing utility class to `lightning:button`.

```
<lightning:button name="submit" label="Submit" class="slds-m-around_medium"/>
```

The class you add is appended to other base classes that are applied to the component, resulting in the following markup.

```
<button class="slds-button slds-button_neutral slds-m-around_medium"
       type="button" name="submit">Submit</button>
```

Similarly, you can create a custom class and pass it into the `class` attribute.

```
<lightning:badge label="My badge" class="myCustomClass"/>
```

You have the flexibility to customize the components at a granular level beyond the CSS scaffolding we provide. Let's look at the `lightning:card` component, where you can create your own body markup. You can apply the `slds-p-horizontal_small` or `slds-card__body_inner` class in the body markup to add padding around the body.

```
<!-- lightning:card example using slds-p-horizontal_small class -->
<lightning:card>
  <aura:set attribute="title">My Account</aura:set>
  <aura:set attribute="footer">Footer</aura:set>
  <aura:set attribute="actions">
    <lightning:button label="New"/>
  </aura:set>
</lightning:card>
```

```
</aura:set>
<p class="slds-p-horizontal_small">
  Card Body
</p>
</lightning:card>

<!-- lightning:card example using slds-card__body_inner -->
<lightning:card>
  <aura:set attribute="title">My Account</aura:set>
  <aura:set attribute="footer">Footer</aura:set>
  <aura:set attribute="actions">
    <lightning:button label="New"/>
  </aura:set>
  <div class="slds-card__body_inner">
    Card Body
  </div>
</lightning:card>
```

Block-Element-Modifier (BEM) Notation

CSS class names used by Lightning base components match the Block-Element-Modifier (BEM) notation that Salesforce Lightning Design System uses. Class names that previously contained a double dash now use a single underscore in place of the double dash. A CSS class that used to be `slds-p-around--small` is now `slds-p-around_small`, for example. If you have created custom CSS in your components that reference an SLDS class that contains a double dash, update your selectors to use a single underscore. For more information, see [Lightning Design System FAQ](#).

Applying Custom Component Styling

Sometimes the utility classes aren't enough and you want to add custom styling in your component bundle. You saw earlier that you can create a custom class and pass it into the `class` attribute. We recommend that you create a class instead of targeting a class name you don't own, since those classes might change anytime. For example, don't try to target `.slds-input` or `.lightningInput`, as they are CSS classes that are available by default in base components. You can also consider using tokens to ensure that your design is consistent across your components. Specify values in the token bundle and reuse them in your components' CSS resources.

Showing and Hiding with Styles

Lightning Design System utility classes include visibility classes that enable you to show and hide elements. These classes are designed as show/hide pairs that you add and remove, or toggle, with JavaScript. Apply only one class at a time. See [Lightning Design System: Utilities: Visibility](#) for descriptions of the classes. For information about using JavaScript to toggle markup see [Dynamically Showing or Hiding Markup](#).

Using the Grid for Layout

`lightning:layout` is your answer to a flexible grid system. You can achieve a simple layout by enclosing `lightning:layoutItem` components within `lightning:layout`, which creates a `div` container with the `slds-grid` class. To apply additional Lightning Design System grid classes, specify any combination of the `lightning:layout` attributes. For example, specify `vertical-align="stretch"` to append the `slds-grid_vertical-stretch` class. You can apply Lightning Design System grid classes to the component using the `horizontalAlign`, `verticalAlign`, and `pullToBoundary` attributes. However, not all grid classes are available through these attributes. To provide additional grid classes, use the `class` attribute. The following grid classes can be added using the `class` attribute.

- .slds-grid_frame
- .slds-grid_vertical
- .slds-grid_reverse
- .slds-grid_vertical-reverse
- .slds-grid_pull-padded-x-small
- .slds-grid_pull-padded-xx-small
- .slds-grid_pull-padded-xxx-small

This example adds the `slds-grid_reverse` class to the `slds-grid` class.

```
<lightning:layout horizontalAlign="space" class="slds-grid_reverse">
  <lightning:layoutItem padding="around-small">
    <!-- more markup here -->
  </lightning:layoutItem>
  <!-- more lightning:layoutItem components here -->
</lightning:layout>
```

For more information, see [Grid utility](#).

Applying Variants to Base Components

Variants on a component refer to design variations for that component, enabling you to change the appearance of the component easily. While we try to match base component variants to their respective Lightning Design System variants, it's not a one-to-one correspondence. Most base components provide a `variant` attribute. For example, `lightning:button` support many variants—base, neutral, brand, destructive, and inverse—to apply different text and background colors on the buttons.

```
<lightning:button variant="brand" label="Brand" onclick="{!! c.handleClick }" />
```

Notice the `success` variant is not supported. However, you can add the `slds-button_success` class to achieve the same result.

```
<lightning:button name="submit" label="Submit" class="slds-button_success"/>
```

Let's look at another example. You can create a group of related information using the `lightning:tile` component. Although this component doesn't provide a `variant` attribute, you can achieve the Lightning Design System board variant by passing in the `slds-tile_board` class.

```
<aura:component>
  <ul class="slds-has-dividers_around-space">
    <li class="slds-item">
      <lightning:tile label="Anypoint Connectors" href="/path/to/somewhere" class="slds-tile_board">
        <p class="slds-text-heading_medium">$500,000</p>
        <p class="slds-truncate" title="Company One"><a href="#">Company One</a></p>
        <p class="slds-truncate">Closing 9/30/2015</p>
      </lightning:tile>
    </li>
  </ul>
</aura:component>
```

If you don't see a variant you need, check to see if you can pass in a Lightning Design System class to the base component before creating your own custom CSS class. Don't be afraid to experiment with Lightning Design System classes and variants in base components. For more information, see [Lightning Design System](#).

SEE ALSO:

- [Styling Apps](#)
- [Styling with Design Tokens](#)

Working with Lightning Design System Variants

Base component variants correspond to variants in Lightning Design System. Variants change the appearance of a component and are controlled by the `variant` attribute.

If you pass in a variant that's not supported, the default variant is used instead. This example creates a button with the base variant.

```
<lightning:button variant="base" label="Base" onclick="{!! c.handleClick }"/>
```

The following reference describes how variants in base components correspond to variants in Lightning Design System. Base components that don't have any visual styling, such as `lightning:formattedDateTime`, are not listed here.

 **Note:** Interactive examples for the following components are available in the [Component Library](#).

Accordion

A `lightning:accordion` component is a collection of vertically stacked sections with content areas. The sections are defined with `lightning:accordionSection` components. By default, only one section is expanded at a time. The `allowMultipleSectionsOpen` attribute enables you to expand more than one section. This component does not support the `variant` attribute. `lightning:accordion` uses the styling from [Accordion](#) in the Lightning Design System.

▼ Accordion Title A

This is the content area for section A.

➤ Accordion Title B

➤ Accordion Title C

Avatar

A `lightning:avatar` component is an image that represents an object, such as an account or user. You can create avatars in different sizes and two variants. `lightning:avatar` uses the styling from [Avatar](#) in the Lightning Design System.



| Base Component Variant | Lightning Design System Class Name | Description |
|------------------------|------------------------------------|---------------------------------------|
| square (default) | slds-avatar | An avatar with a rounded square shape |
| circle | slds-avatar_circle | An avatar with a circular shape |

Badge

A `lightning:badge` component is a label containing a small amount of information. This component does not support the `variant` attribute. `lightning:badge` uses the styling from [Badges](#) in the Lightning Design System.

LABEL

Breadcrumb

A `lightning:breadcrumb` component displays the path of a page relative to a parent page. Breadcrumbs are nested in a `lightning:breadcrumbs` component. This component does not support the `variant` attribute. `lightning:breadcrumb` uses the styling from [Breadcrumbs](#) in the Lightning Design System.

PARENT ENTITY > PARENT RECORD NAME

Button

A `lightning:button` component is a button that executes an action in a client-side controller. Buttons can be one of three types: button (default), reset, and submit. Buttons support icons to the left or right of the text label. `lightning:button` uses the styling from [Buttons](#) in the Lightning Design System.



| Base Component Variant | Lightning Design System Class Name | Description |
|------------------------|--------------------------------------|---|
| neutral (default) | <code>slds-button_neutral</code> | A button with gray border and white background |
| base | <code>slds-button</code> | A button without a border, which appears like a text link |
| brand | <code>slds-button_brand</code> | A blue button with white text |
| destructive | <code>slds-button_destructive</code> | A red button with white text |
| inverse | <code>slds-button_inverse</code> | A button for dark backgrounds |
| success | <code>slds-button_success</code> | A green button |

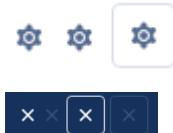
Button Group

A `lightning:buttonGroup` component is a group of buttons that can be displayed together to create a navigational bar. You can nest `lightning:button` and `lightning:buttonMenu` components in the group. Although the button group itself doesn't support the `variant` attribute, variants are supported for buttons and the button menu components. For example, you can nest `<lightning:button variant="inverse" label="Refresh" />` in a button group. If including `lightning:buttonMenu`, place it after the buttons and pass in the `slds-button_last` class to adjust the border. `lightning:buttonGroup` uses the styling from [Button Groups](#) in the Lightning Design System.



Button Icon

A `lightning:buttonIcon` component is an icon-only button that executes an action in a client-side controller. You can create button icons in different sizes. Only Lightning Design System [utility icons](#) are supported. `lightning:buttonIcon` uses the styling from [Button Icons](#) in the Lightning Design System.



| Base Component Variant | Lightning Design System Class Name | Description |
|------------------------|--|---|
| border (default) | <code>slds-button_icon-border</code> | A button that contains an icon with gray border |
| bare | <code>slds-button_icon</code> | A button that looks like a plain icon |
| brand | <code>slds-button_icon-brand</code> | A button that uses the Salesforce blue background color |
| container | <code>slds-button_icon-container</code> | A 32px by 32px button that looks like a plain icon |
| border-filled | <code>slds-button_icon-border-filled</code> | A button that contains an icon with gray border and white background |
| bare-inverse | <code>slds-button_icon-inverse</code> | A button that contains a white icon without borders for a dark background |
| border-inverse | <code>slds-button_icon-border-inverse</code> | A button that contains a white icon for a dark background |

Button Icon (Stateful)

A `lightning:buttonIconStateful` component is an icon-only button that retains state. You can press the button to toggle between states. You can create button icons in different sizes. Only Lightning Design System [utility icons](#) are supported. The `selected` attribute appends the `slds-is-selected` class when it's set to `true`. `lightning:buttonIconStateful` uses the styling from [Button Icons](#) in the Lightning Design System.



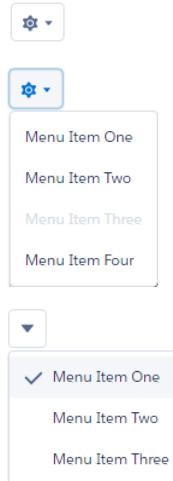
| Base Component Variant | Lightning Design System Class Name | Description |
|------------------------|--|---|
| border (default) | <code>slds-button_icon-border</code> | A button that contains an icon with gray border |
| border-filled | <code>slds-button_icon-border-filled</code> | A button that contains an icon with a white background |
| border-inverse | <code>slds-button_icon-border-inverse</code> | A button that contains a white icon for a dark background |

Button Menu

A `lightning:buttonMenu` component is a dropdown menu with a list of menu items, represented by `lightning:menuItem` components. Menu items can be checked or unchecked, or execute an action in a client-side controller. You can create button menus with icons in different sizes and position the dropdown menu in different locations relative to the button. The variants change the appearance of the button, and are similar to the variants on button icons.

`lightning:buttonMenu` supports the `lightning:menuDivider` component for creating horizontal lines between menu items. The menu divider has a `compact` variant for reducing the space above and below the line. The `lightning:menuSubheader` component enables you to create subheadings in the list of menu items. It has no variants.

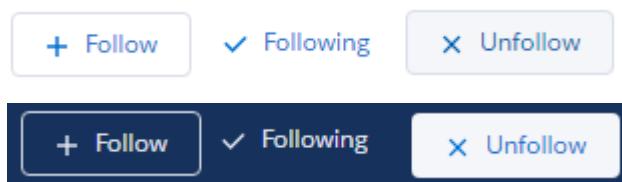
`lightning:buttonMenu` uses the styling from [Menus](#) in the Lightning Design System.



| Base Component Variant | Lightning Design System Class Name | Description |
|------------------------|--|---|
| border (default) | <code>slds-button_icon-border</code> | A button that contains an icon with gray border |
| bare | <code>slds-button_icon</code> | A button that looks like a plain icon |
| container | <code>slds-button_icon-container</code> | A 32px by 32px button that looks like a plain icon |
| border-filled | <code>slds-button_icon-border-filled</code> | A button that contains an icon with gray border and white background |
| bare-inverse | <code>slds-button_icon-inverse</code> | A button that contains a white icon without borders for a dark background |
| border-inverse | <code>slds-button_icon-border-inverse</code> | A button that contains a white icon for a dark background |

Button (Stateful)

A `lightning:buttonStateful` component is a button that toggles between states. Stateful buttons can show a different label and icon based on their states. Only Lightning Design System [utility icons](#) are supported. `lightning:buttonStateful` uses the styling from [Buttons](#) in the Lightning Design System.

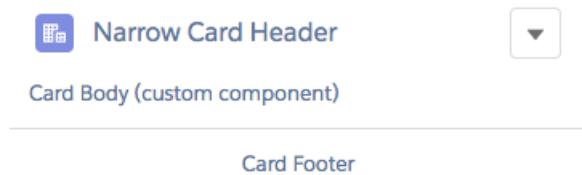


| Base Component Variant | Lightning Design System Class Name | Description |
|------------------------|------------------------------------|--|
| neutral (default) | <code>slds-button_neutral</code> | A button with gray border and white background |

| Base Component Variant | Lightning Design System Class Name | Description |
|------------------------|------------------------------------|--|
| brand | slds-button_brand | A blue button with white text |
| destructive | slds-button_destructive | A red button with white text |
| inverse | slds-button_inverse | A button for dark backgrounds |
| success | slds-button_success | A green button |
| text | slds-button | A button that contains an icon with gray border and white background |

Card

A `lightning:card` component is used to apply a stylized container around a grouping of information in an `article` HTML tag. The information could be a single item or a group of items such as a related list. `lightning:card` uses the styling from [Cards](#) in the Lightning Design System.

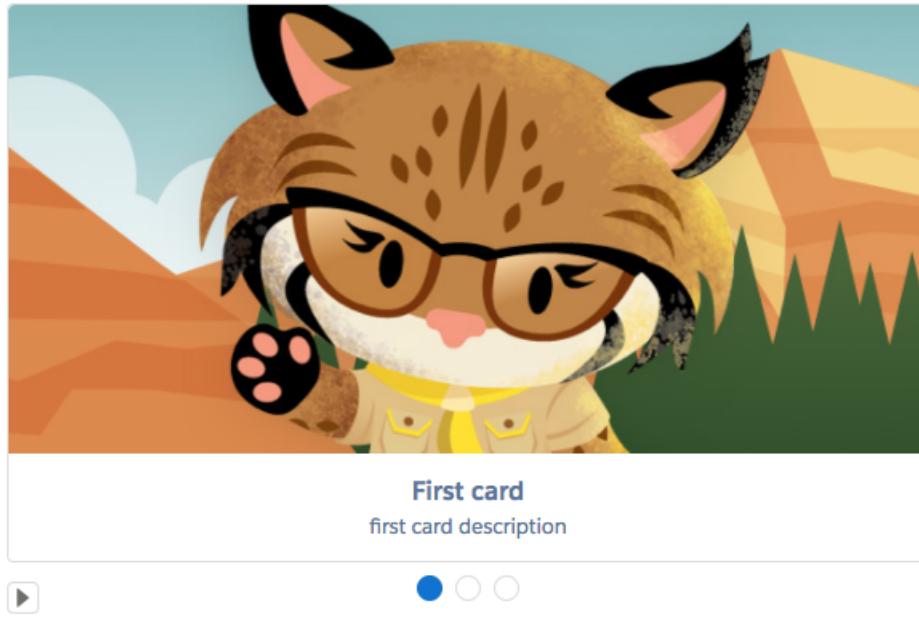


Card Footer

| Base Component Variant | Lightning Design System Class Name | Description |
|------------------------|------------------------------------|--|
| base (default) | slds-card | A group of related information that takes the width of the container |
| narrow | slds-card_narrow | A group of related information that has narrow width |

Carousel

A `lightning:carousel` component is a collection of images that are displayed horizontally one at a time. Specify the images using `lightning:carouselImage` child components. The carousel doesn't support the `variant` attribute, and it uses the `slds-carousel` class on the outer element. `lightning:carousel` uses the styling from [Carousel](#) in the Lightning Design System.



Checkbox Group

A `lightning:checkboxGroup` component is a group of checkboxes that enables selection of single or multiple options. This component is different from `lightning:input` of `type="checkbox"` as the latter is not suitable for grouping a set of checkboxes together. Although the checkbox group doesn't support the `variant` attribute, the `slds-form-element` class is appended to the `fieldset` element that encloses the checkbox group. `lightning:checkboxGroup` uses the styling from [Checkbox](#) in the Lightning Design System.

Members
 Gloria
 Noel

Combobox

A `lightning:combobox` component is an input element that enables single selection from a list of options. The result of the selection is displayed as the value of the input. In a multi-select combobox, each selected option is displayed in a pill below the input element. `lightning:combobox` uses the styling from [Combobox](#) in the Lightning Design System.

Status

In Progress

- New
- In Progress
- Finished

| Base Component Variant | Lightning Design System Class Name | Description |
|------------------------|---|--|
| standard (default) | <code>slds-input</code> <code>slds-form-element</code> | A combobox that enables single or multiple selection |

| Base Component Variant | Lightning Design System Class Name | Description |
|------------------------|---|--------------------------------------|
| | slds-form-element__control slds-combobox | |
| label-hidden | N/A | An input element with a hidden label |

Data Table and Tree Grid

A `lightning:datatable` component is a table that displays columns of data, formatted according to type. It enables resizing of columns, header-level actions, row-level actions, selecting of rows, sorting of columns, text wrapping and clipping, row numbering, and cell content alignment. Although the data table doesn't support the `variant` attribute, the `slds-table` and `slds-table_bordered` classes are appended to the `table` element. Component attributes and column properties set in the client-side controller enable you to customize tables. `lightning:datatable` uses the styling from [Data Tables](#) in the Lightning Design System.

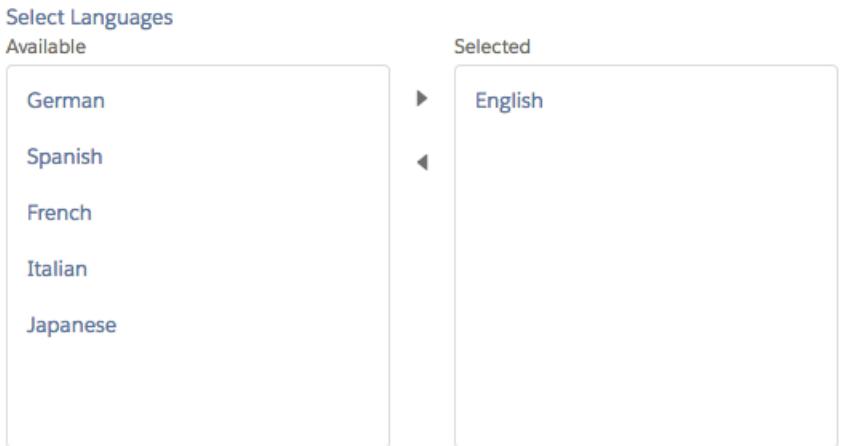
| OPPORTUNITY ... | ACCOUNT NAME | CLOSE DATE | CONFIDENCE | AMOUNT |
|-----------------------|--------------|------------|------------|------------|
| Schimmel, Schim... | Myra | 7/23/2017 | 93% | €73,640.00 |
| McKenzie, McKen... | Kaley | 7/18/2017 | 29% | €29,027.00 |
| Bartoletti-Bartoletti | Letitia | 7/15/2017 | 80% | €13,000.00 |
| Pagac-Pagac | Beryl | 7/17/2017 | 37% | €70,094.00 |
| Emard LLC | Myron | 7/23/2017 | 35% | €90,457.00 |

Similar in appearance to `lightning:datatable`, `lightning:treeGrid` is a hierarchical view of data presented in a table. It uses the styling from [Trees](#) in the Lightning Design System.

| <input type="checkbox"/> ACCOUNT NAME | EMPLOYEES | PHONE NUMBER | ACCOUNT OWNER |
|---|-----------|--------------|---------------|
| <input type="checkbox"/> Rewis Inc | 3,100 | 837-555-1212 | Jane Doe |
| <input type="checkbox"/> Acme Corporation | 10,000 | 837-555-1212 | John Doe |
| <input type="checkbox"/> Acme Corporation (Bay Area) | 3,000 | 837-555-1212 | John Doe |
| <input type="checkbox"/> Acme Corporation (Oakland) | 745 | 837-555-1212 | John Doe |
| <input type="checkbox"/> Acme Corporation (San Francisco) | 578 | 837-555-1212 | Jane Doe |

Dual Listbox

A `lightning:dualListbox` component provides two list boxes, where you can move one or more options to the second list box and reorder the selected options. `lightning:dualListbox` uses the styling from [Dueling Picklist](#) in the Lightning Design System.



| Base Component Variant | Lightning Design System Class Name | Description |
|------------------------|------------------------------------|-------------------------------------|
| standard (default) | slds-dueling-list | A dual listbox with a visible label |
| label-hidden | N/A | A dual listbox with a hidden label |

Dynamic Icon

A `lightning:dynamicIcon` component represents various animated icons. The `type` attribute determines the animated icon to display and corresponds to the dynamic icons in the Lightning Design System. `lightning:dynamicIcon` uses the styling from [Dynamic Icons](#) in the Lightning Design System.



File Uploader

A `lightning:fileUpload` component enables file uploads to a record. The file uploader includes drag-and-drop functionality and filtering by file types. Although it doesn't support the `variant` attribute, the `slds-file-selector` class is appended to the component. `lightning:fileUpload` uses the styling from [FileSelector](#) in the Lightning Design System.



Form Layout

A form layout represents a set of interactive controls to submit user input, which can include compound fields such as fields for addresses, names, or geolocation. These components use the styling from [Form Layout](#) in the Lightning Design System.

`lightning:inputAddress` displays an address compound field.

* ADDRESS

* Street

* City * Province

| | |
|---------------|----|
| San Francisco | CA |
|---------------|----|

* PostalCode Country

| | |
|-------|----|
| 94105 | US |
|-------|----|

`lightning:inputName` displays a name compound field.

Salutation

| | |
|-----|---|
| Mr. | ▼ |
|-----|---|

First Name

| |
|------|
| John |
|------|

Last Name

| |
|-----|
| Doe |
|-----|

`lightning:inputField` displays an editable field with a label, help text, and value that correspond to a record field on a Salesforce object. The field's data type determines the component that's used for the input field. The `lightning:inputField` component must be nested in a `lightning:recordEditForm` component.

First Name

| | |
|------|---|
| Andy | ✉ |
|------|---|

* Last Name

| |
|-------|
| Young |
|-------|

Birthdate

| | |
|--|---|
| | 📅 |
|--|---|

Business Phone

| |
|----------------|
| (785) 241-6200 |
|----------------|

Lead Source ⓘ

| | |
|----------------|---|
| Purchased List | ▼ |
|----------------|---|

Update record

`lightning:outputField` displays a read-only field with a label, help text, and value of a record field on a Salesforce object. The component has a `label-hidden` variant to hide the label. `lightning:outputField` is used in `lightning:recordViewForm` and `lightning:recordEditForm` components.

The `lightning:recordForm` component eases record form creation. It accepts a `mode` attribute to specify variants of the form. The component creates an edit form that can create or update records, a view form with the option to edit fields, and a read-only form. The layout of the form is set with other attributes. The `lightning:recordForm` component uses `lightning:recordEditForm` and `lightning:recordViewForm` to create the forms.

The edit mode form with a single column layout:

The screenshot shows a lightning:recordForm in view mode. The form has a two-column layout. The left column contains fields for Salutation (Mr.), First Name (Geoff), Last Name (Minor), Minor (info@salesforce.net), Business Phone ((415) 555-5555), and Title (Chairman of the Board). The right column contains fields for Account ID (Global Media) and a Save button.

The view mode form with two column layout:

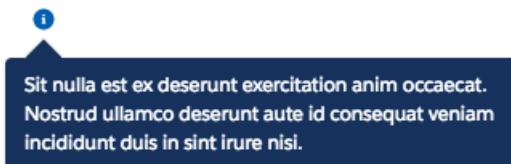
The screenshot shows a lightning:recordForm in edit mode. The form has a two-column layout. The left column contains fields for Full Name (Mr. Geoff Minor), Business Phone ((415) 555-5555), and Account ID (Global Media). The right column contains fields for Email (info@salesforce.net) and Title (Chairman of the Board), each with an edit icon.

The read-only mode form with two column layout:

The screenshot shows a lightning:recordForm in read-only mode. The form has a two-column layout. The left column contains fields for Full Name (Jon Amos), Business Phone (58033390345), and Account ID (Global Media). The right column contains fields for Email (info@salesforce.org) and Title (Sales Manager).

Help Text (Tooltip)

A lightning:helptext component displays an icon with a popover containing a small amount of text describing an element on screen. The `iconVariant` attribute changes the appearance of the help text icon and supports the same variants as the lightning:icon component. You can also change the default icon using the `iconName` attribute to specify a different utility icon. The `slds-popover` and `slds-popover_tooltip` classes are applied to the tooltip. lightning:helptext uses the styling from [Tooltips](#) in the Lightning Design System.



| iconVariant Values | Lightning Design System Class Name | Description |
|--------------------|------------------------------------|----------------------------|
| inverse | slds-icon | An icon with a white fill |
| error | slds-icon-text-error | An icon with a red fill |
| warning | slds-icon-text-warning | An icon with a yellow fill |

Icon

A `lightning:icon` component is a visual element that provides context and enhances usability. Although all Lightning Design System icons are supported, only utility icons support variants. You can create icons in different sizes. You can also use a custom svg sprite and specify a path to the resource instead of using Lightning Design System icons. `lightning:icon` uses the styling from [Icons](#) in the Lightning Design System.



| Base Component Variant | Lightning Design System Class Name | Description |
|------------------------|------------------------------------|----------------------------|
| inverse | slds-icon | An icon with a white fill |
| error | slds-icon-text-error | An icon with a red fill |
| warning | slds-icon-text-warning | An icon with a yellow fill |

Input

A `lightning:input` component is an interactive control, such as an input field or checkbox, which accepts user input. `lightning:input` uses the styling from [Input](#) in the Lightning Design System.

Input Four
123

Input Five
12,345

Input Six
50%

Input Seven
\$123.45

Input One

Input Two

Input Three

Input Four

* Input Two

Input Three

| Base Component Variant | Lightning Design System Class Name | Description |
|------------------------|---|---|
| standard (default) | slds-input slds-form-element slds-form-element__control | An input element, which can be an input field, checkbox, toggle, radio button, or other types. The class appended to the element depends on the input type. |
| label-hidden | N/A | An input element with a hidden label |

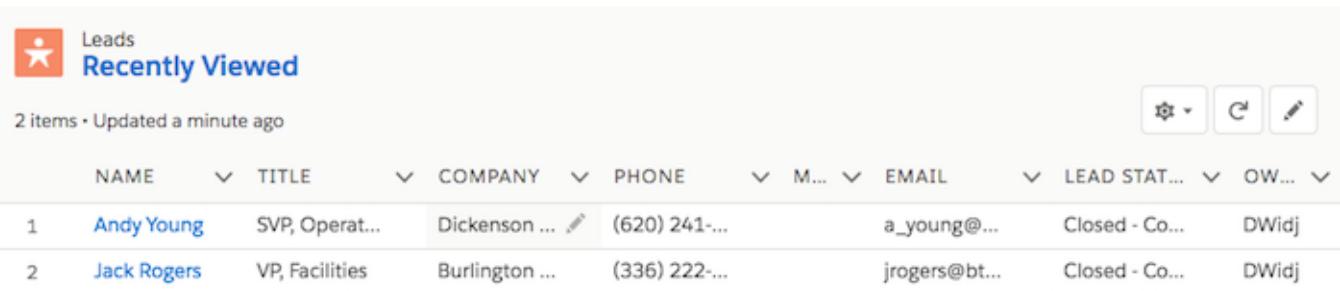
Layout

A `lightning:layout` component is a flexible grid system for arranging containers within a page or another container. The `lightning:layoutItem` component is used to specify the items inside the layout. The component does not support the `variant` attribute. Customization of the layout is controlled by `horizontalAlign`, `verticalAlign`, `pullToBoundary`, and `multipleRows` attributes of `lightning:layout`. The attributes of `lightning:layoutItem` enable you to configure the size of the layout item, and change how the layout is configured on different device sizes.

`lightning:layout` uses the styling from [Grid](#) in the Lightning Design System. For more information, see [Lightning Design System Considerations](#).

List View

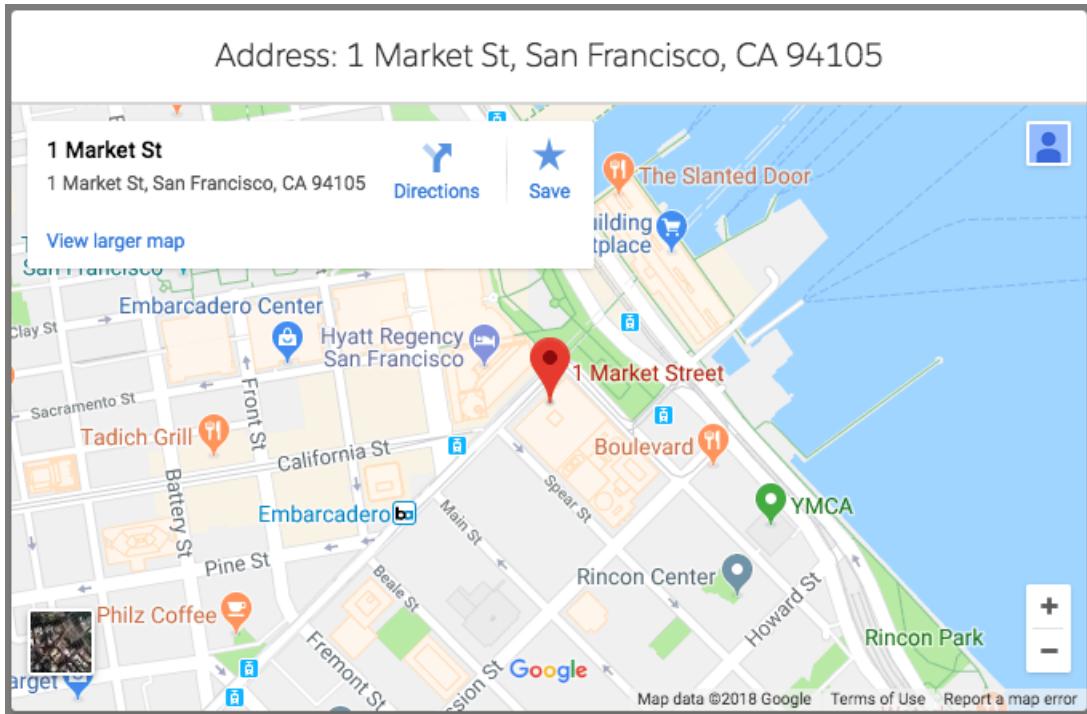
A `lightning:listView` component represents a list view of records that you own or have read or write access to, and records shared with you. Inline edit, row level actions, and the action bar are supported in Lightning Experience, the Salesforce app, and communities only. On a desktop, this component renders a full list view. On all other form factors, such as a tablet or mobile devices, the component renders a mobile-friendly alternative.



| Recently Viewed | | | | | | | |
|--|-------------|---|--------------------------------------|---------------|---------------|----------------|-------|
| Leads | | Recently Viewed | | | | | |
| 2 items • Updated a minute ago | | grid icon refresh icon edit icon | | | | | |
| NAME ▾ TITLE ▾ COMPANY ▾ PHONE ▾ M... ▾ EMAIL ▾ LEAD STAT... ▾ OW... ▾ | | | | | | | |
| 1 | Andy Young | SVP, Operat... | Dickenson ... edit icon | (620) 241-... | a_young@... | Closed - Co... | DWidj |
| 2 | Jack Rogers | VP, Facilities | Burlington ... | (336) 222-... | jrogers@bt... | Closed - Co... | DWidj |

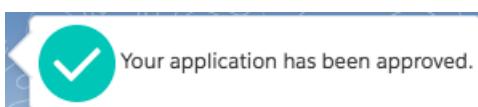
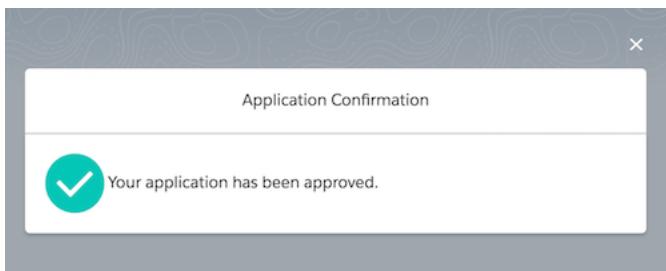
Map

A `lightning:map` component securely displays a map of one or more locations. The component does not support the `variant` attribute. It supports attributes that enable you to add a title for a list of locations and a footer. `lightning:map` uses the styling from [Map](#) in the Lightning Design System.

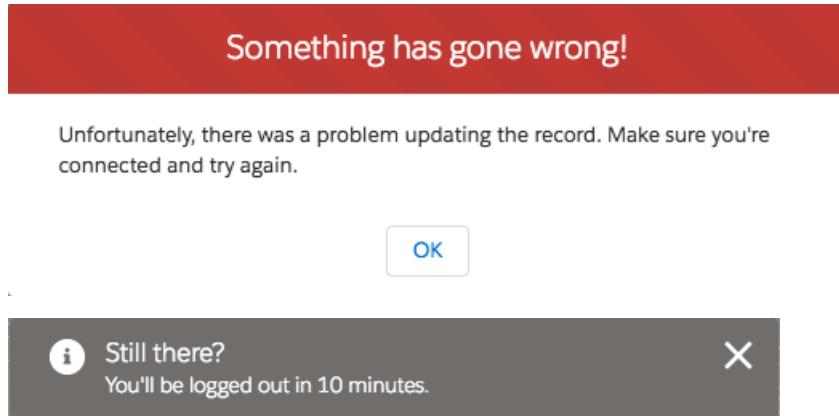


Messaging

Messaging components communicate relevant information, such as for engagement or feedback. These components use styling from [Messaging](#) in the Lightning Design System. `lightning:overlayLibrary` display messages via modals and popovers. A modal blocks everything else on the page until it's dismissed, while popovers display contextual information on a reference element and don't interrupt like modals.



`lightning:notificationsLibrary` display messages via notices and toasts. Notices interrupt the user's workflow and block everything else on the page, while toasts are less intrusive than notices and are suitable for providing feedback following an action.



Pill

A `lightning:pill` component is a text label that's wrapped by a rounded border and displayed with a remove button. Pills can contain an icon or avatar next to the text label. This component does not support the `variant` attribute, but its content and other attributes determine the styling applied to them. For example, a pill with `hasError="true"` displays as a pill with a red border and error icon. `lightning:pill` uses the styling from [Pills](#) in the Lightning Design System.



Additionally, you can display pills in a container using the `lightning:pillContainer` component.



Progress Bar

A `lightning:progressBar` component displays a horizontal progress bar from left to right to indicate the progress of an operation. It uses the styling from [Progress Bar](#) in the Lightning Design System.



| Base Component Variant | Lightning Design System Class Name | Description |
|------------------------|---|----------------------------------|
| base (default) | <code>slds-progress-bar</code> | A basic progress bar |
| circular | <code>slds-progress-bar_circular</code> | A progress bar with rounded ends |

Progress Indicator and Path

A `lightning:progressIndicator` component displays the steps in a process and indicates what has been completed. The nested `lightning:progressStep` component defines the label and value to display for each step. The `type` attribute determines if progress indicators or a path is displayed. When using `type="base"`, the `variant` attribute is available.

`lightning:progressIndicator` uses the styling from [Progress Indicator](#) and [Path](#) in the Lightning Design System.



The `variant` attribute is not available when `type="path"`.

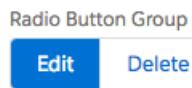
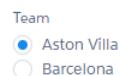


Additionally, `lightning:path` and `lightning:picklistPath` enables you to display the progress of a process on a record based on a specified picklist field. `lightning:path` displays a path based on your Path Settings in Setup and `lightning:picklistPath` displays a path derived from the `picklistFieldApiName` attribute.

| Base Component Variant | Lightning Design System Class Name | Description |
|------------------------|------------------------------------|--|
| base (default) | slds-progress | For <code>type="base"</code> only. Indicates steps in a process. |
| shaded | slds-progress_shade | For <code>type="base"</code> only. Adds a shaded background to the current step. |

Radio Group

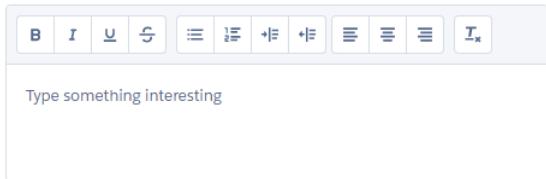
A `lightning:radioGroup` component is a group of radio buttons that enables selection of a single option. The `type` attribute determines if a group of typical radio buttons or rectangular buttons is displayed. `lightning:radioGroup` uses the styling from [Radio Group](#) in the Lightning Design System.



| Base Component Variant | Lightning Design System Class Name | Description |
|------------------------|---------------------------------------|--|
| standard (default) | slds-radio slds-radio_button-group | A group of radio buttons or rectangular buttons |
| label-hidden | N/A | A group of radio buttons or rectangular buttons with a label that's hidden |

Rich Text Editor

A `lightning:inputRichText` component is a rich text editor with a customizable toolbar. The toolbar displays at the top of the editor but you can change its position to below the editor using the `bottom-toolbar` variant. To add an image button to the toolbar, nest the `lightning:insertImageButton` component inside `lightning:inputRichText`. The button opens a file browser to upload an image to insert in the text editor. `lightning:inputRichText` uses the styling from [Rich Text Editor](#) in the Lightning Design System.



| Base Component Variant | Lightning Design System Class Name | Description |
|------------------------|---------------------------------------|---|
| bottom-toolbar | slds-rich-text-editor__toolbar-bottom | A rich text editor with a toolbar placed below the editor |

Select

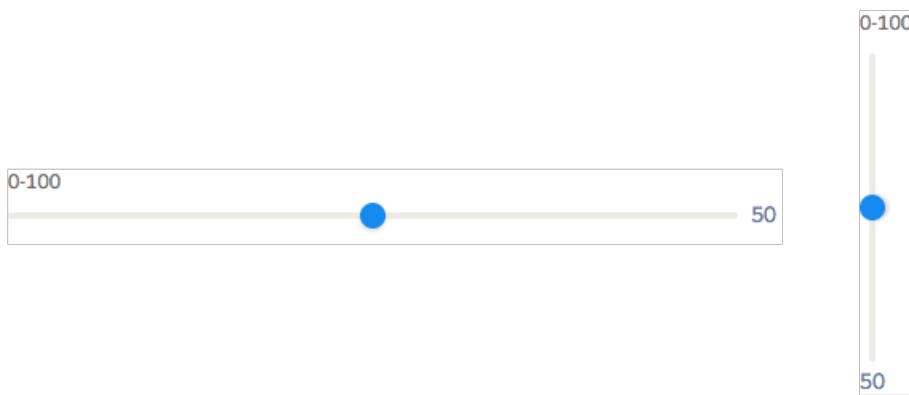
A `lightning:select` component is a dropdown list that enables you to select a single option. `lightning:select` uses the styling from [Select](#) in the Lightning Design System.



| Base Component Variant | Lightning Design System Class Name | Description |
|------------------------|------------------------------------|---|
| standard (default) | slds-select | A select input element that supports single selection of values |
| label-hidden | N/A | A select input element with a hidden label |

Slider

A `lightning:slider` component is a slider for specifying a value between two specified numbers. The `type` attribute determines if a horizontal (default) or vertical slider is displayed. `lightning:slider` uses the styling from [Slider](#) in the Lightning Design System.



| Base Component Variant | Lightning Design System Class Name | Description |
|------------------------|------------------------------------|--|
| standard (default) | slds-slider-label | A slider with an optional visible label. |
| label-hidden | N/A | A slider with a hidden label |

Spinner

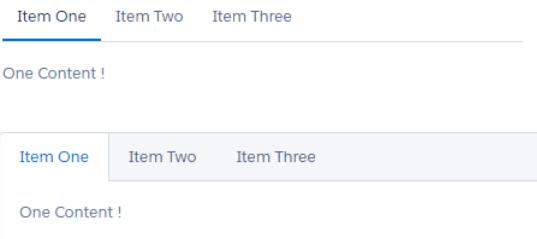
A `lightning:spinner` component is a spinner that indicates data is loading. You can create spinners in different sizes. `lightning:spinner` uses the styling from [Spinners](#) in the Lightning Design System.



| Base Component Variant | Lightning Design System Class Name | Description |
|------------------------|------------------------------------|---------------------------------------|
| base (default) | slds-spinner | A gray spinner |
| brand | slds-spinner_brand | A blue spinner |
| inverse | slds-spinner_inverse | A white spinner for a dark background |

Tabs

A `lightning:tabset` component is a list of tabs with corresponding content areas, represented by `lightning:tab` components. `lightning:tabset` uses the styling from [Tabs](#) in the Lightning Design System.



| Base Component Variant | Lightning Design System Class Name | Description |
|------------------------|------------------------------------|---|
| default | slds-tabs_default | A list of tabs and content areas without borders |
| scoped | slds-tabs_scoped | A list of tabs and content areas with borders |
| vertical | slds-vertical-tabs | A list of tabs that are displayed vertically to the left of the content areas |

Textarea

A `lightning:textarea` component is an input field for multi-line text input. It uses the styling from [Textarea](#) in the Lightning Design System.

Input Three

| Base Component Variant | Lightning Design System Class Name | Description |
|------------------------|------------------------------------|--|
| standard (default) | slds-form-element | A textarea element with a text label |
| label-hidden | N/A | A textarea element with a hidden label |

Tile

A `lightning:tile` component is a group of related information associated with a record. This component does not support variants, but you can pass in the `slds-tile_board` class to create a board. Similarly, use a definition list in the tile body to create a tile with an icon or use an unordered list to create a list of tiles with avatars. `lightning:tile` uses the styling from [Tiles](#) in the Lightning Design System.

Salesforce UX
Company: Salesforce
Email: salesforce-ux@salesforce.com

Bruce Wayne
Billionaire, Gotham City • Dark Knight

Clark Kent
Reporter, Daily Planet • Man of Steel

Diana Prince
Honorary Ambassador, United Nations • The Amazon Princess

Tree

A `lightning:tree` component is a visualization of a structure hierarchy. A tree item, also known as a branch, can be expanded or collapsed. Although this component does not support the `variant` attribute, it uses the styling from [Trees](#) in the Lightning Design System.

ROLES

- ▽ Western Sales Director
 - ▽ Western Sales Manager
 - CA Sales Rep
 - OR Sales Rep
 - Eastern Sales Director

Vertical Navigation

A `lightning:verticalNavigation` component is a list of links that are one level deep, with support for icons and overflow sections that collapse and expand. Although this component does not support the `variant` attribute, you can use the `compact` and `shaded` attributes to achieve compact spacing and styling for a shaded background. The component supports subcomponents that enable you to add icons, badges, and overflow content.

`lightning:verticalNavigation` uses the styling from [Vertical Navigation](#) in the Lightning Design System.

The sidebar shows the following structure:

- REPORTS**
 - Recent
 - Created by Me
 - Private Reports
 - Public Reports
 - All Reports
- FOLDERS**
 - Created by Me
 - Shared with Me

Working with UI Components

The framework provides common user interface components in the `ui` namespace. All of these components extend either `aura:component` or a child component of `aura:component`. `aura:component` is an abstract component that provides a default rendering implementation. User interface components such as `ui:input` and `ui:output` provide easy handling of common user interface events like keyboard and mouse interactions. Each component can be styled and extended accordingly.

 **Note:** If you are looking for components that apply the Lightning Design System styling, consider using the base lightning components instead.

For all the components available, see the component reference at <https://<myDomain>.lightning.force.com/auradocs/reference.app>, where `<myDomain>` is the name of your custom Salesforce domain.

Complex, Interactive Components

The following components contain one or more sub-components and are interactive.

| Type | Key Components | Description |
|---------|-----------------------------------|---|
| Message | <code>ui:message</code> | A message notification of varying severity levels |
| Menu | <code>ui:menu</code> | A drop-down list with a trigger that controls its visibility |
| | <code>ui:menuList</code> | A list of menu items |
| | <code>ui:actionMenuItem</code> | A menu item that triggers an action |
| | <code>ui:checkboxMenuItem</code> | A menu item that supports multiple selection and can be used to trigger an action |
| | <code>ui:radioMenuItem</code> | A menu item that supports single selection and can be used to trigger an action |
| | <code>ui:menuItemSeparator</code> | A visual separator for menu items |

| Type | Key Components | Description |
|------|--------------------|--|
| | ui:menuItem | An abstract and extensible component for menu items in a ui:menuList component |
| | ui:menuTrigger | A trigger that expands and collapses a menu |
| | ui:menuTriggerLink | A link that triggers a dropdown menu. This component extends ui:menuTrigger |

Input Control Components

The following components are interactive, for example, like buttons and checkboxes.

| Type | Key Components | Description |
|----------------|----------------------|---|
| Button | ui:button | An actionable button that can be pressed or clicked |
| Checkbox | ui:inputCheckbox | A selectable option that supports multiple selections |
| | ui:outputCheckbox | Displays a read-only value of the checkbox |
| Radio button | ui:inputRadio | A selectable option that supports only a single selection |
| Drop-down List | ui:inputSelect | A drop-down list with options |
| | ui:inputSelectOption | An option in a ui:inputSelect component |

Visual Components

The following components provides informative cues, for example, like error messages and loading spinners.

| Type | Key Components | Description |
|-------------------|----------------------|---|
| Field-level error | ui:inputDefaultError | An error message that is displayed when an error occurs |
| Spinner | ui:spinner | A loading spinner |

Field Components

The following components enables you to enter or display values.

| Type | Key Components | Description |
|---------------|-------------------|--|
| Currency | ui:inputCurrency | An input field for entering currency |
| | ui:outputCurrency | Displays currency in a default or specified format |
| Email | ui:inputEmail | An input field for entering an email address |
| | ui:outputEmail | Displays a clickable email address |
| Date and time | ui:inputDate | An input field for entering a date |

| Type | Key Components | Description |
|--------------|-------------------|---|
| Text | ui:inputDateTime | An input field for entering a date and time |
| | ui:outputDate | Displays a date in the default or specified format |
| | ui:outputDateTime | Displays a date and time in the default or specified format |
| Password | ui:inputSecret | An input field for entering secret text |
| Phone Number | ui:inputPhone | An input field for entering a telephone number |
| | ui:outputPhone | Displays a phone number |
| Number | ui:inputNumber | An input field for entering a numerical value |
| | ui:outputNumber | Displays a number |
| Range | ui:inputRange | An input field for entering a value within a range |
| Rich Text | ui:inputRichText | An input field for entering rich text |
| | ui:outputRichText | Displays rich text |
| Text | ui:inputText | An input field for entering a single line of text |
| | ui:outputText | Displays text |
| Text Area | ui:inputTextArea | An input field for entering multiple lines of text |
| | ui:outputTextArea | Displays a read-only text area |
| URL | ui:inputURL | An input field for entering a URL |
| | ui:outputURL | Displays a clickable URL |

SEE ALSO:

- [Using the UI Components](#)
- [Creating Components](#)
- [Component Bundles](#)

Event Handling in UI Components

UI components provide easy handling of user interface events such as keyboard and mouse interactions. By listening to these events, you can also bind values on UI input components using the `updateOn` attribute, such that the values update when those events are fired.

Capture a UI event by defining its handler on the component. For example, you want to listen to the HTML DOM event, `onblur`, on a `ui:inputTextArea` component.

```
<ui:inputTextArea aura:id="textarea" value="My text area" label="Type something"
blur="{!c.handleBlur}" />
```

The `blur=" {!c.handleBlur}"` listens to the `onblur` event and wires it to your client-side controller. When you trigger the event, the following client-side controller handles the event.

```
handleBlur : function(cmp, event, helper) {
    var elem = cmp.find("textare").getElement();
    //do something else
}
```

For all available events on all components, see the [Component Library](#) on page 468.

Value Binding for Browser Events

Any changes to the UI are reflected in the component attribute, and any change in that attribute is propagated to the UI. When you load the component, the value of the input elements are initialized to those of the component attributes. Any changes to the user input causes the value of the component variable to be updated. For example, a `ui:inputText` component can contain a value that's bound to a component attribute, and the `ui:outputText` component is bound to the same component attribute. The `ui:inputText` component listens to the `onkeyup` browser event and updates the corresponding component attribute values.

```
<aura:attribute name="first" type="String" default="John"/>
<aura:attribute name="last" type="String" default="Doe"/>

<ui:inputText label="First Name" value=" {!v.first}" updateOn="keyup"/>
<ui:inputText label="Last Name" value=" {!v.last}" updateOn="keyup"/>

<!-- Returns "John Doe" -->
<ui:outputText value=" {!v.first + ' ' + v.last}"/>
```

The next example takes in numerical inputs and returns the sum of those numbers. The `ui:inputNumber` component listens to the `onkeyup` browser event. When the value in this component changes on the keyup event, the value in the `ui:outputNumber` component is updated as well, and returns the sum of the two values.

```
<aura:attribute name="number1" type="integer" default="1"/>
<aura:attribute name="number2" type="integer" default="2"/>

<ui:inputNumber label="Number 1" value=" {!v.number1}" updateOn="keyup" />
<ui:inputNumber label="Number 2" value=" {!v.number2}" updateOn="keyup" />

<!-- Adds the numbers and returns the sum -->
<ui:outputNumber value=" {(v.number1 * 1) + (v.number2 * 1)}"/>
```

 **Note:** The input fields return a string value and must be properly handled to accommodate numerical values. In this example, both values are multiplied by 1 to obtain their numerical equivalents.

Using the UI Components

Users interact with your app through input elements to select or enter values. Components such as `ui:inputText` and `ui:inputCheckbox` correspond to common input elements. These components simplify event handling for user interface events.

 **Note:** For all available component attributes and events, see the component reference at <https://<myDomain>.lightning.force.com/auradocs/reference.app>, where `<myDomain>` is the name of your custom Salesforce domain.

To use input components in your own custom component, add them to your .cmp or .app resource. This example is a basic set up of a text field and button. The `aura:id` attribute defines a unique ID that enables you to reference the component from your JavaScript code using `cmp.find("myID");`

```
<ui:inputText label="Name" aura:id="name" placeholder="First, Last"/>
<ui:outputText aura:id="nameOutput" value="" />
<ui:button aura:id="outputButton" label="Submit" press=" {!c.getInput} " />
```

 **Note:** All text fields must specify the `label` attribute to provide a textual label of the field. If you must hide the label from view, set `labelClass="assistiveText"` to make the label available to assistive technologies.

The `ui:outputText` component acts as a placeholder for the output value of its corresponding `ui:inputText` component. The value in the `ui:outputText` component can be set with the following client-side controller action.

```
getInput : function(cmp, event) {
    var fullName = cmp.find("name").get("v.value");
    var outName = cmp.find("nameOutput");
    outName.set("v.value", fullName);
}
```

The following example is similar to the previous, but uses value binding without a client-side controller. The `ui:outputText` component reflects the latest value on the `ui:inputText` component when the `onkeyup` browser event is fired.

```
<aura:attribute name="first" type="String" default="John"/>
<aura:attribute name="last" type="String" default="Doe"/>

<ui:inputText label="First Name" value=" {!v.first}" updateOn="keyup"/>
<ui:inputText label="Last Name" value=" {!v.last}" updateOn="keyup"/>

<!-- Returns "John Doe" -->
<ui:outputText value=" {!v.first + ' ' + v.last} "/>
```

 **Tip:** To create and edit records in the Salesforce app, use the `force:createRecord` and `force:recordEdit` events to utilize the built-in record create and edit pages.

Supporting Accessibility

When customizing components, be careful in preserving code that ensures accessibility, such as the `aria` attributes.

Accessible software and assistive technology enable users with disabilities to use and interact with the products you build. Aura components are created according to W3C specifications so that they work with common assistive technologies. While we always recommend that you follow the [WCAG Guidelines](#) for accessibility when developing with the Lightning Component framework, this guide explains the accessibility features that you can leverage when using components in the `ui` namespace.

IN THIS SECTION:

- [Button Labels](#)
- [Audio Messages](#)
- [Forms, Fields, and Labels](#)
- [Events](#)
- [Menus](#)

Button Labels

Buttons can appear with text only, an icon and text, or an icon without text. To create an accessible button, use `lightning:button` and set a textual label using the `label` attribute.

 **Note:** You can create accessible buttons using `ui:button` but they don't come with Lightning Design System styling. We recommend using `lightning:button` instead.

Button with text only:

```
<lightning:button label="Search" onclick="{!!c.doSomething}" />
```

Button with icon and text:

```
<lightning:button label="Download" iconName="utility:download" onclick="{!!c.doSomething}" />
```

Button with icon only:

```
<lightning:buttonIcon iconName="utility:settings" alternativeText="Settings" onclick="{!!c.doSomething}" />
```

The `alternativeText` attribute provides a text label that's hidden from view and available to assistive technology.

This example shows the HTML generated by `lightning:button`:

```
<!-- Good: using span/assistiveText to hide the label visually, but show it to screen  
readers -->  
<button>  
  ::before  
  <span class="slds-assistive-text">Settings</span>  
</button>
```

Audio Messages

To convey audio notifications, use the `ui:message` component, which has `role="alert"` set on the component by default. The "alert" aria role will take any text inside the div and read it out loud to screen readers without any additional action by the user.

```
<ui:message title="Error" severity="error" closable="true">  
  This is an error message.  
</ui:message>
```

Forms, Fields, and Labels

Input components are designed to make it easy to assign labels to form fields. Labels build a programmatic relationship between a form field and its textual label. When using a placeholder in an input component, set the `label` attribute for accessibility.

Use `lightning:input` to create accessible input fields and forms. You can use `lightning:textarea` in preference to the `<textarea>` tag for multi-line text input or `lightning:select` instead of the `<select>` tag.

```
<lightning:input name="myInput" label="Search" />
```

If your code fails, check the label element during component rendering. A label element should have the `for` attribute and match the value of input control id attribute, OR the label should be wrapped around an input. Input controls include `<input>`, `<textarea>`, and `<select>`.

Here's an example of the HTML generated by `lightning:input`.

```
<!-- Good: using label/for= -->
<label for="fullname">Enter your full name:</label>
<input type="text" id="fullname" />

<!-- Good: --using implicit label>
<label>Enter your full name:
    <input type="text" id="fullname"/>
</label>
```

SEE ALSO:

[Using Labels](#)

Events

Although you can attach an `onclick` event to any type of element, for accessibility, consider only applying this event to elements that are actionable in HTML by default, such as `<a>`, `<button>`, or `<input>` tags in component markup. You can use an `onclick` event on a `<div>` tag to prevent event bubbling of a click.

Menus

A menu is a dropdown list with a trigger that controls its visibility. You must provide the trigger, which displays a text label, and a list of menu items. The dropdown menu and its menu items are hidden by default. You can change this by setting the `visible` attribute on the `ui:menuList` component to `true`. The menu items are shown only when you click the `ui:menuTriggerLink` component.

This example code creates a menu with several items:

```
<ui:menu>
    <ui:menuTriggerLink aura:id="trigger" label="Opportunity Status"/>
        <ui:menuList class="actionMenu" aura:id="actionMenu">
            <ui:actionMenuItem aura:id="item2" label="Open"
click="{!c.updateTriggerLabel}"/>
            <ui:actionMenuItem aura:id="item3" label="Closed"
click="{!c.updateTriggerLabel}"/>
            <ui:actionMenuItem aura:id="item4" label="Closed Won"
click="{!c.updateTriggerLabel}"/>
        </ui:menuList>
</ui:menu>
```

Different menus achieve different goals. Make sure you use the right menu for the desired behavior. The three types of menus are:

Actions

Use the `ui:actionMenuItem` for items that create an action, like print, new, or save.

Radio button

If you want users to pick only one from a list several items, use `ui:radioMenuItem`.

Checkbox style

If users can pick multiple items from a list of several items, use `ui:checkboxMenuItem`. Checkboxes can also be used to turn one item on or off.



Note: To create a dropdown menu with a trigger that's a button, use `lightning:buttonMenu` instead.

CHAPTER 4 Using Components

In this chapter ...

- [Aura Component Bundle Design Resources](#)
- [Use Aura Components in Lightning Experience and the Salesforce Mobile App](#)
- [Navigate Across Your Apps with Page References](#)
- [Get Your Aura Components Ready to Use on Lightning Pages](#)
- [Use Aura Components in Community Builder](#)
- [Use Aura Components with Flows](#)
- [Add Components to Apps](#)
- [Integrate Your Custom Apps into the Chatter Publisher](#)
- [Using Background Utility Items](#)
- [Use Lightning Components in Visualforce Pages](#)
- [Add Aura Components to Any App with Lightning Out \(Beta\)](#)
- [Lightning Container](#)

You can use components in many different contexts. This section shows you how.

Aura Component Bundle Design Resources

Use a design resource to control which attributes are exposed to builder tools like the Lightning App Builder, Community Builder, or Flow Builder. A design resource lives in the same folder as your .cmp resource, and describes the design-time behavior of the Aura component—information that visual tools need to display the component in a page or app.

For example, here's a simple design resource that goes in a bundle with a "Hello World" component.

```
<design:component label="Hello World">
  <design:attribute name="subject" label="Subject" description="Name of the person you
want to greet" />
  <design:attribute name="greeting" label="Greeting" />
</design:component>
```

design:component

This is the root element for the design resource. It contains the component's design-time configuration for tools such as the App Builder to use.

| Attribute | Description |
|-----------|--|
| label | Sets the label of the component when it displays in tools such as App Builder. When creating a custom Lightning page template component, this text displays as the name of the template in the Lightning App Builder new page wizard. |

 **Note:** Label expressions in markup are supported in .cmp and .app resources only.

design:attribute

To make an Aura component attribute available for admins to edit in tools such as the App Builder, add a `design:attribute` node for the attribute into the design resource. An attribute marked as required in the component definition automatically appears, unless it has a default value assigned to it.

For Lightning page interfaces, the design resource supports only attributes of type `Integer`, `String`, or `Boolean`. To see which attribute types the `lightning:availableForFlowScreens` interface supports, go to [Which Aura Attribute Types Are Supported in Flows?](#).

 **Note:** In a `design:attribute` node, Flow Builder supports only the `name`, `label`, `description`, and `default` attributes. The other attributes, like `min` and `max`, are ignored.

| Attribute | Description |
|------------|--|
| datasource | Renders a field as a picklist, with static values. Only supported for String attributes. <code><design:attribute name="Name" datasource="value1,value2,value3" /></code> You can also set the picklist values dynamically using an Apex class. See Create Dynamic Picklists for Your Custom Components on page 180 for more information. Any String attribute with a <code>datasource</code> in a design resource is treated as a picklist. |

| Attribute | Description |
|-------------|--|
| default | Sets a default value on an attribute in a design resource. <code><design:attribute name="Name" datasource="value1,value2,value3" default="value1" /></code> |
| description | Displays as an i-bubble for the attribute in the tool. |
| label | Attribute label that displays in the tool. |
| max | If the attribute is an <code>Integer</code> , this sets its maximum allowed value. If the attribute is a <code>String</code> , this is the maximum length allowed. |
| min | If the attribute is an <code>Integer</code> , this sets its minimum allowed value. If the attribute is a <code>String</code> , this is the minimum length allowed. |
| name | Required attribute. Its value must match the <code>aura:attribute</code> name value in the .cmp resource. |
| placeholder | Input placeholder text for the attribute when it displays in the tool. |
| required | Denotes whether the attribute is required. If omitted, defaults to <code>false</code> . |



Note: Label expressions in markup are supported in .cmp and .app resources only.

<sfdc:object> and <sfdc:objects>

Use these tag sets to restrict your component to one or more objects.



Note: <sfdc:object> and <sfdc:objects> aren't supported in Community Builder or the Flow Builder. They're also ignored when setting a component to use as an object-specific action or to override a standard action.

Here's the same "Hello World" component's design resource restricted to two objects.

```
<design:component label="Hello World">
    <design:attribute name="subject" label="Subject" description="Name of the person you
want to greet" />
    <design:attribute name="greeting" label="Greeting" />
    <sfdc:objects>
        <sfdc:object>Custom__c</sfdc:object>
        <sfdc:object>Opportunity</sfdc:object>
    </sfdc:objects>
</design:component>
```

If an object is installed from a package, add the `namespace_` string to the beginning of the object name when including it in the <sfdc:object> tag set. For example: `objectNamespace__ObjectApiName__c`.

SEE ALSO:

[Configure Components for Lightning Pages and the Lightning App Builder](#)

[Tips and Considerations for Configuring Components for Lightning Pages and the Lightning App Builder](#)

Use Aura Components in Lightning Experience and the Salesforce Mobile App

Customize and extend Lightning Experience and the Salesforce app with Aura components. Launch components from tabs, apps, and actions.

IN THIS SECTION:

[Configure Components for Custom Tabs](#)

Add the `force:appHostable` interface to an Aura component to allow it to be used as a custom tab in Lightning Experience or the Salesforce mobile app.

[Add Lightning Components as Custom Tabs in a Lightning Experience App](#)

Make your Lightning components available for Lightning Experience users by displaying them in a custom tab in a Lightning Experience app.

[Add Lightning Components as Custom Tabs in the Salesforce App](#)

Make your Lightning components available for Salesforce for Android, Salesforce for iOS, and Salesforce mobile web users by displaying them in a custom tab.

[Lightning Component Actions](#)

Lightning component actions are custom actions that invoke a Lightning component. They support Apex and JavaScript and provide a secure way to build client-side custom functionality. Lightning component actions are supported only in the Salesforce mobile app and Lightning Experience.

[Override Standard Actions with Aura Components](#)

Add the `lightning:actionOverride` interface to an Aura component to enable the component to be used to override a standard action on an object. You can override the View, New, Edit, and Tab standard actions on most standard and all custom components. Overriding standard actions allows you to customize your org using Lightning components, including completely customizing the way you view, create, and edit records.

Configure Components for Custom Tabs

Add the `force:appHostable` interface to an Aura component to allow it to be used as a custom tab in Lightning Experience or the Salesforce mobile app.

Components that implement this interface can be used to create tabs in both Lightning Experience and the Salesforce app.

Example: Example Component

```
<!--simpleTab.cmp-->
<aura:component implements="force:appHostable">

    <!-- Simple tab content -->

    <h1>Lightning Component Tab</h1>

</aura:component>
```

The `appHostable` interface makes the component available for use as a custom tab. It doesn't require you to add anything else to the component.

Add Lightning Components as Custom Tabs in a Lightning Experience App

Make your Lightning components available for Lightning Experience users by displaying them in a custom tab in a Lightning Experience app.

In the components you wish to include in Lightning Experience, add `implements="force:appHostable"` in the `aura:component` tag and save your changes.

Editions

Available in: Salesforce Classic ([not available in all orgs](#)) and Lightning Experience

Available for use in: **Contact Manager, Group, Professional, Enterprise, Performance, Unlimited, and Developer** Editions

Create Lightning components using the UI in **Enterprise, Performance, Unlimited, Developer** Editions, or a sandbox.

User Permissions

To create Lightning Component Tabs:

- Customize Application

```
<aura:component implements="force:appHostable">
```

To create Aura components, use the Developer Console.

To display Lightning components in a custom tab in a Lightning Experience app, you must enable My Domain.

Follow these steps to include your components in Lightning Experience and make them available to users in your organization.

1. Create a custom tab for this component.

- From Setup, enter `Tabs` in the Quick Find box, then select **Tabs**.
- Click **New** in the Lightning Component Tabs related list.
- Select the Lightning component that you want to make available to users.
- Enter a label to display on the tab.
- Select the tab style and click **Next**.
- When prompted to add the tab to profiles, accept the default and click **Save**.

2. Add your Lightning components to the App Launcher.

- From Setup, enter `Apps` in the Quick Find box, then select **App Manager > New Lightning App**.
- Follow the steps in the wizard. On the Select Items page, select the Lightning tab from the Available Items list and move it to the Selected Items list.
- Finish the steps in the wizard, and click **Save & Finish**.

3. To check your output, navigate to the App Launcher in Lightning Experience. Click the custom app to see the components that you added.

Add Lightning Components as Custom Tabs in the Salesforce App

Make your Lightning components available for Salesforce for Android, Salesforce for iOS, and Salesforce mobile web users by displaying them in a custom tab.

 **Note:** To add a Lightning web component as a custom tab, wrap it in an Aura component. See [Lightning Web Components Developer Guide](#).

In the component you wish to add, include `implements="force:appHostable"` in your `aura:component` tag and save your changes.

EDITIONS

Available in: Salesforce Classic ([not available in all orgs](#)) and Lightning Experience

Available for use in: **Contact Manager, Group, Professional, Enterprise, Performance, Unlimited, and Developer** Editions

Create Lightning components using the UI in **Enterprise, Performance, Unlimited, Developer** Editions, or a sandbox.

USER PERMISSIONS

To create Lightning Component Tabs:

- Customize Application

```
<aura:component implements="force:appHostable">
```

The `appHostable` interface makes the component available as a custom tab.

To create Aura components, use the Developer Console.

Include your components in the navigation menu by following these steps.

1. Create a custom Lightning component tab for the component. From Setup, enter `Tabs` in the Quick Find box, then select **Tabs**.

 **Note:** You must create a custom Lightning component tab before you can add your component to the navigation menu. Accessing your Lightning component from the full Salesforce site is not supported.

2. Add your Lightning component to the Salesforce app navigation menu.

- a. From Setup, enter `Navigation` in the Quick Find box, then select **Salesforce Navigation**.
- b. Select the custom tab you just created and click **Add**.
- c. Sort items by selecting them and clicking **Up** or **Down**.

In the navigation menu, items appear in the order you specify. The first item in the Selected list becomes your users' landing page.

- Check your output by going to Salesforce mobile web. Your new menu item should appear in the navigation menu.



Note: By default, Salesforce mobile web is turned on for your org. For more information on using mobile web, see the [Salesforce App Developer Guide](#).

Lightning Component Actions

Lightning component actions are custom actions that invoke a Lightning component. They support Apex and JavaScript and provide a secure way to build client-side custom functionality. Lightning component actions are supported only in the Salesforce mobile app and Lightning Experience.



Note: My Domain must be deployed in your org for Lightning component actions to work properly.

You can add Lightning component actions to an object's page layout using the page layout editor. If you have Lightning component actions in your org, you can find them in the Mobile & Lightning Actions category in the page layout editor's palette.

Lightning component actions can't call just any Lightning component in your org. For a component to work as a Lightning component action, it must be configured for that purpose and implement either the `force:LightningQuickAction` or `force:LightningQuickActionWithoutHeader` interfaces. You must also set a default value for each component attribute marked as required.

If you plan on packaging a Lightning component action, the component the action invokes must be marked as `access=global`.

IN THIS SECTION:

[Configure Components for Custom Actions](#)

Add the `force:lightningQuickAction` or `force:lightningQuickActionWithoutHeader` interface to an Aura component to enable it to be used as a custom action in Lightning Experience or the Salesforce mobile app. You can use components that implement one of these interfaces as object-specific or global actions in both Lightning Experience and the Salesforce app.

[Configure Components for Record-Specific Actions](#)

Add the `force:hasRecordId` interface to an Aura component to enable the component to be assigned the ID of the current record. The current record ID is useful if the component is used on a Lightning record page, as an object-specific custom action or action override in Lightning Experience or the Salesforce app, and so on.

Configure Components for Custom Actions

Add the `force:lightningQuickAction` or `force:lightningQuickActionWithoutHeader` interface to an Aura component to enable it to be used as a custom action in Lightning Experience or the Salesforce mobile app. You can use components that implement one of these interfaces as object-specific or global actions in both Lightning Experience and the Salesforce app.

When used as actions, components that implement the `force:lightningQuickAction` interface display in a panel with standard action controls, such as a **Cancel** button. These components can display and implement their own controls in the body of the panel, but can't affect the standard controls. It should nevertheless be prepared to handle events from the standard controls.

If instead you want complete control over the user interface, use the `force:lightningQuickActionWithoutHeader` interface. Components that implement `force:lightningQuickActionWithoutHeader` display in a panel without additional controls and are expected to provide a complete user interface for the action.

EDITIONS

Available in: both the Salesforce mobile app and Lightning Experience

Available in: **Essentials, Group, Professional, Enterprise, Performance, Unlimited, Contact Manager, and Developer** Editions

These interfaces are mutually exclusive. That is, components can implement either the `force:lightningQuickAction` interface or the `force:lightningQuickActionWithoutHeader` interface, but not both. This should make sense; a component can't both present standard user interface elements and *not* present standard user interface elements.

 **Note:** For your Aura component to work as a custom action, you must set a default value for each component attribute marked as required.

Example: Example Component

Here's an example of a component that can be used for a custom action, which you can name whatever you want—perhaps "Quick Add". (A component and an action that uses it don't need to have matching names.) This component quickly adds two numbers together.

```
<!--quickAdd.cmp-->
<aura:component implements="force:lightningQuickAction">

    <!-- Very simple addition -->

    <lightning:input type="number" name="myNumber" aura:id="num1" label="Number 1"/>
+
    <lightning:input type="number" name="myNumber" aura:id="num2" label="Number 2"/>

    <br/>
    <lightning:button label="Add" onclick="{!c.clickAdd}" />

</aura:component>
```

The component markup simply presents two input fields, and an **Add** button.

The component's controller does all the real work.

```
/*quickAddController.js*/
({
    clickAdd: function(component, event, helper) {
        // Get the values from the form
        var n1 = component.find("num1").get("v.value");
        var n2 = component.find("num2").get("v.value");

        // Display the total in a "toast" status message
        var resultsToast = $A.get("e.force:showToast");
        resultsToast.setParams({
            "title": "Quick Add: " + n1 + " + " + n2,
            "message": "The total is: " + (n1 + n2) + "."
        });
        resultsToast.fire();

        // Close the action panel
        var dismissActionPanel = $A.get("e.force:closeQuickAction");
        dismissActionPanel.fire();
    }
})
```

Retrieving the two numbers entered by the user is straightforward, though a more robust component would check for valid inputs, and so on. The interesting part of this example is what happens to the numbers and how the custom action resolves.

The results of the add calculation are displayed in a “toast,” which is a status message that appears at the top of the page. The toast is created by firing the `force:showToast` event. A toast isn’t the only way you could display the results, nor are actions the only use for toasts. It’s just a handy way to show a message at the top of the screen in Lightning Experience or the Salesforce app.

What’s interesting about using a toast here, though, is what happens afterward. The `clickAdd` controller action fires the `force:closeQuickAction` event, which dismisses the action panel. But, even though the action panel is closed, the toast still displays. The `force:closeQuickAction` event is handled by the action panel, which closes. The `force:showToast` event is handled by the `one.app` container, so it doesn’t need the panel to work.

SEE ALSO:

[Configure Components for Record-Specific Actions](#)

Configure Components for Record-Specific Actions

Add the `force:hasRecordId` interface to an Aura component to enable the component to be assigned the ID of the current record. The current record ID is useful if the component is used on a Lightning record page, as an object-specific custom action or action override in Lightning Experience or the Salesforce app, and so on.

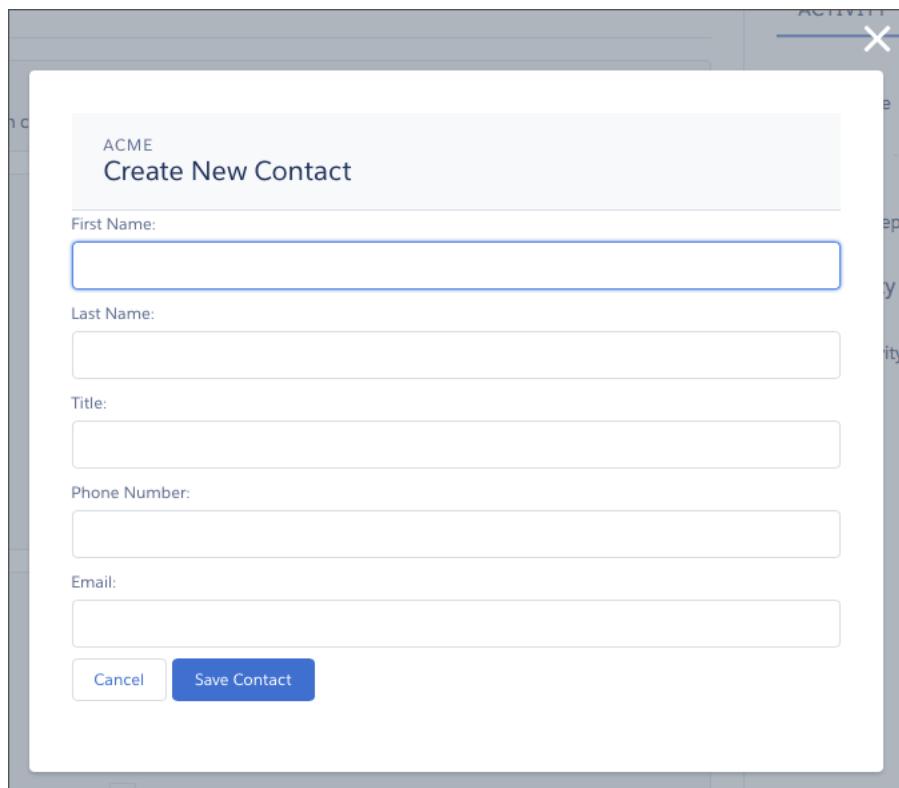
`force:hasRecordId` is a *marker interface*. A marker interface is a signal to the component’s container to add the interface’s behavior to the component.

The `recordId` attribute is set only when you place or invoke the component in an explicit record context. For example, when you place the component directly on a record page layout, or invoke it as an object-specific action from a record page or object home. In all other cases, such as when you invoke the component as a global action, or create the component programmatically inside another component, `recordId` isn’t set, and your component shouldn’t depend on it.



Example: Example of a Component for a Record-Specific Action

This extended example shows a component designed to be invoked as a custom object-specific action from the detail page of an account record. After creating the component, you need to create the custom action on the account object, and then add the action to an account page layout. When opened using an action, the component appears in an action panel that looks like this:



The component definition begins by implementing both the `force:lightningQuickActionWithoutHeader` and the `force:hasRecordId` interfaces. The first makes it available for use as an action and prevents the standard controls from displaying. The second adds the interface's automatic record ID attribute and value assignment behavior, when the component is invoked in a record context.

`quickContact cmp`

```
<aura:component controller="QuickContactController"
    implements="force:lightningQuickActionWithoutHeader, force:hasRecordId">

    <aura:attribute name="account" type="Account" />
    <aura:attribute name="newContact" type="Contact"
        default="{ 'sobjectType': 'Contact' }" /> <!-- default to empty record -->

    <aura:handler name="init" value="={!this}" action=" {!c.doInit} " />

    <!-- Display a header with details about the account -->
    <div class="slds-page-header" role="banner">
        <p class="slds-text-heading_label">{!v.account.Name}</p>
        <h1 class="slds-page-header__title slds-m-right_small
            slds-truncate slds-align-left">Create New Contact</h1>
    </div>

    <!-- Display the new contact form -->
    <lightning:input aura:id="contactField" name="firstName" label="First Name"
        value=" {!v.newContact.FirstName}" required="true"/>

    <lightning:input aura:id="contactField" name="lastname" label="Last Name"
        value=" {!v.newContact.LastName}" required="true"/>

```

```

        value="={!v.newContact.LastName}" required="true"/>

<lightning:input aura:id="contactField" name="title" label="Title"
    value="={!v.newContact.Title}" />

<lightning:input aura:id="contactField" type="phone" name="phone" label="Phone
Number"
    pattern="^((1?(-?\d{3})-?)?(\d{3}))(-?\d{4})$"
    messageWhenPatternMismatch="The phone number must contain 7, 10,
or 11 digits. Hyphens are optional."
    value=" {!v.newContact.Phone}" required="true"/>

<lightning:input aura:id="contactField" type="email" name="email" label="Email"
    value=" {!v.newContact.Email}" />

<lightning:button label="Cancel" onclick=" {!c.handleClickCancel}"
class="slds-m-top_medium" />
<lightning:button label="Save Contact" onclick=" {!c.handleClickSaveContact}"
    variant="brand" class="slds-m-top_medium"/>

</aura:component>

```

The component defines the following attributes, which are used as member variables.

- *account*—holds the full account record, after it's loaded in the init handler
- *newContact*—an empty contact, used to capture the form field values

The rest of the component definition is a standard form that displays an error on the field if the required fields are empty or the phone field doesn't match the specified pattern.

The component's controller has all of the interesting code, in three action handlers.

`quickContactController.js`

```

({
    doInit : function(component, event, helper) {

        // Prepare the action to load account record
        var action = component.get("c.getAccount");
        action.setParams({ "accountId": component.get("v.recordId") });

        // Configure response handler
        action.setCallback(this, function(response) {
            var state = response.getState();
            if(state === "SUCCESS") {
                component.set("v.account", response.getReturnValue());
            } else {
                console.log('Problem getting account, response state: ' + state);
            }
        });
        $A.enqueueAction(action);
    },

    handleSaveContact: function(component, event, helper) {
        if(helper.validateContactForm(component)) {

```

```

        // Prepare the action to create the new contact
        var saveContactAction = component.get("c.saveContactWithAccount");
        saveContactAction.setParams({
            "contact": component.get("v.newContact"),
            "accountId": component.get("v.recordId")
        });

        // Configure the response handler for the action
        saveContactAction.setCallback(this, function(response) {
            var state = response.getState();
            if(state === "SUCCESS") {

                // Prepare a toast UI message
                var resultsToast = $A.get("e.force:showToast");
                resultsToast.setParams({
                    "title": "Contact Saved",
                    "message": "The new contact was created."
                });

                // Update the UI: close panel, show toast, refresh account page
                $A.get("e.force:closeQuickAction").fire();
                resultsToast.fire();
                $A.get("e.force:refreshView").fire();
            }
            else if (state === "ERROR") {
                console.log('Problem saving contact, response state: ' + state);
            }
            else {
                console.log('Unknown problem, response state: ' + state);
            }
        });
    });

    // Send the request to create the new contact
    $A.enqueueAction(saveContactAction);
}

,

handleCancel: function(component, event, helper) {
    $A.get("e.force:closeQuickAction").fire();
}
})

```

The first action handler, `doInit`, is an init handler. Its job is to use the record ID that's provided via the `force:hasRecordId` interface and load the full account record. Note that there's nothing to stop this component from being used in an action on another object, like a lead, opportunity, or custom object. In that case, `doInit` will fail to load a record, but the form will still display.

The `handleSaveContact` action handler validates the form by calling a helper function. If the form isn't valid, the field-level errors are displayed. If the form is valid, then the action handler:

- Prepares the server action to save the new contact.
- Defines a callback function, called the *response handler*, for when the server completes the action. The response handler is discussed in a moment.

- Enqueues the server action.

The server action's response handler does very little itself. If the server action was successful, the response handler:

- Closes the action panel by firing the `force:closeQuickAction` event.
- Displays a "toast" message that the contact was created by firing the `force:showToast` event.
- Updates the record page by firing the `force:refreshView` event, which tells the record page to update itself.

This last item displays the new record in the list of contacts, once that list updates itself in response to the refresh event.

The `handleCancel` action handler closes the action panel by firing the `force:closeQuickAction` event.

The component helper provided here is minimal, sufficient to illustrate its use. You'll likely have more work to do in any production quality form validation code.

`quickContactHelper.js`

```
{
    validateContactForm: function(component) {
        var validContact = true;

        // Show error messages if required fields are blank
        var allValid = component.find('contactField').reduce(function (validFields,
inputCmp) {
            inputCmp.showHelpMessageIfInvalid();
            return validFields && inputCmp.get('v.validity').valid;
        }, true);

        if (allValid) {
            // Verify we have an account to attach it to
            var account = component.get("v.account");
            if($A.util.isEmpty(account)) {
                validContact = false;
                console.log("Quick action context doesn't have a valid account.");
            }
        }

        return(validContact);
    }
}
})
```

Finally, the Apex class used as the server-side controller for this component is deliberately simple to the point of being obvious.

`QuickContactController.apxc`

```
public with sharing class QuickContactController {

    @AuraEnabled
    public static Account getAccount(Id accountId) {
        // Perform isAccessible() checks here
        return [SELECT Name, BillingCity, BillingState FROM Account WHERE Id =
:accountId];
    }

    @AuraEnabled
    public static Contact saveContactWithAccount(Contact contact, Id accountId) {
        // Perform isAccessible() and isUpdateable() checks here
    }
}
```

```

        contact.AccountId = accountId;
        upsert contact;
        return contact;
    }

}

```

One method retrieves an account based on the record ID. The other associates a new contact record with an account, and then saves it to the database.

SEE ALSO:

[Configure Components for Custom Actions](#)

Override Standard Actions with Aura Components

Add the `lightning:actionOverride` interface to an Aura component to enable the component to be used to override a standard action on an object. You can override the View, New, Edit, and Tab standard actions on most standard and all custom components. Overriding standard actions allows you to customize your org using Lightning components, including completely customizing the way you view, create, and edit records.

Overriding an action with an Aura component closely parallels overriding an action with a Visualforce page. Choose a Lightning component instead of a Visualforce page in the Override Properties for an action.

Override Standard Button or Link Help for this Page 

View

Overriding a standard button or link changes what happens when a user clicks on it. For example, instead of having a standard Salesforce page appear when a user clicks View, you can have the View button launch a custom s-control, Visualforce page, Lightning component, or Lightning page instead.

Overrides also apply to programmatic customizations of the same actions. For example, firing the View record event uses the same setting, and performs the same action, as the user clicking View for that record.

You can set different override behavior for Salesforce Classic, Lightning Experience, and mobile.

| Override Properties | | Save | Cancel |
|-------------------------------|--|---|--|
| Label | View | | |
| Name | View | | |
| Default | Standard page | | |
| Salesforce Classic Override | <input checked="" type="radio"/> No override (use default)  | <input type="radio"/> Visualforce page | --None--  |
| Lightning Experience Override | <input checked="" type="radio"/> Lightning component | c:expenseOverrideView  | |
| Mobile Override | <input type="radio"/> Lightning component | --None--  | |
| | <input checked="" type="radio"/> Use the Salesforce Classic override | | |

However, there are important differences from Visualforce in how you create Lightning components that can be used as action overrides, and significant differences in how Salesforce uses them. You'll want to read the details thoroughly before you get started, and test carefully in your sandbox or Developer Edition org before deploying to production.

IN THIS SECTION:

[Standard Actions and Overrides Basics](#)

There are six standard actions available on most standard and all custom objects: Tab, List, View, Edit, New, and Delete. In Salesforce Classic, these are all distinct actions.

[Override a Standard Action with an Aura Component](#)

You can override a standard action with an Aura component in both Lightning Experience and mobile.

[Creating an Aura Component for Use as an Action Override](#)

Add the `lightning:actionOverride` interface to an Aura component to allow it to be used as an action override in Lightning Experience or the Salesforce mobile app. Only components that implement this interface appear in the **Lightning component** menu of an object action Override Properties panel.

[Packaging Action Overrides](#)

Action overrides for custom objects are automatically packaged with the custom object. Action overrides for standard objects can't be packaged.

Standard Actions and Overrides Basics

There are six standard actions available on most standard and all custom objects: Tab, List, View, Edit, New, and Delete. In Salesforce Classic, these are all distinct actions.

Lightning Experience and the Salesforce mobile app combine the Tab and List actions into one action, Object Home. However, Object Home is reached via the Tab action in Lightning Experience, and the List action in the Salesforce mobile app. Finally, the Salesforce mobile app has a unique Search action (reached via Tab). (Yes, it's a bit awkward and complicated.)

This table lists the standard actions you can override for an object as the actions are named in Setup, and the resulting action that's overridden in the three different user experiences.

| Override in Setup | Salesforce Classic | Lightning Experience | Mobile |
|-------------------|--------------------|----------------------|---------------|
| Tab | object tab | object home | search |
| List | object list | n/a | object home |
| View | record view | record home | record home |
| Edit | record edit | record edit | record edit |
| New | record create | record create | record create |
| Delete | record delete | record delete | record delete |



Note:

- "n/a" doesn't mean you can't access the standard behavior, and it doesn't mean you can't *override* the standard behavior. It means you can't *access the override*. It's the override's functionality that's not available.
- There are two additional standard actions, Accept and Clone. These actions are more complex, and overriding them is an advanced project. Overriding them isn't supported.

- Action overrides aren't supported in communities.

How and Where You Can Use Action Overrides

Aura components can be used to override the View, New, New Event, Edit, and Tab standard actions in Lightning Experience and the Salesforce mobile app. You can use an Aura component as an override in Lightning Experience and mobile, but not Salesforce Classic.

Override a Standard Action with an Aura Component

You can override a standard action with an Aura component in both Lightning Experience and mobile.

You need at least one Aura component in your org that implements the `lightning:actionOverride` interface. You can use a custom component of your own, or a component from a managed package.

Go to the object management settings for the object with the action you plan to override.

1. Select **Buttons, Links, and Actions**.
2. Select **Edit** for the action you want to override.
3. Select **Lightning component** for the area you want to set the override.
4. From the drop-down menu, select the name of the Lightning component to use as the action override.
5. Select **Save**.

 **Note:** Users won't see changes to action overrides until they reload Lightning Experience or the Salesforce mobile app.

SEE ALSO:

[Salesforce Help: Find Object Management Settings](#)

[Salesforce Help: Override Standard Buttons and Tab Home Pages](#)

Creating an Aura Component for Use as an Action Override

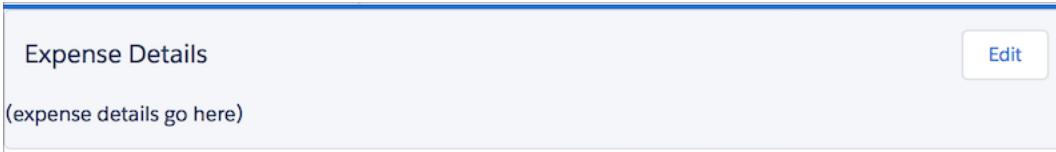
Add the `lightning:actionOverride` interface to an Aura component to allow it to be used as an action override in Lightning Experience or the Salesforce mobile app. Only components that implement this interface appear in the **Lightning component** menu of an object action Override Properties panel.

```
<aura:component
    implements="lightning:actionOverride, force:hasRecordId, force:hasSObjectName">

    <article class="slds-card">
        <div class="slds-card__header slds-grid">
            <header class="slds-media slds-media_center slds-has-flexi-truncate">
                <div class="slds-media__body">
                    <h2><span class="slds-text-heading_small">Expense Details</span></h2>
                </div>
            </header>
            <div class="slds-no-flex">
                <lightning:button label="Edit" onclick="{!!c.handleEdit}"/>
            </div>
        </div>
        <div class="slds-card__body">(expense details go here)</div>
    </article>
</aura:component>
```

```
</article>  
</aura:component>
```

In Lightning Experience, the standard Tab and View actions display as a page, while the standard New and Edit actions display in an overlaid panel. When used as action overrides, Aura components that implement the `lightning:actionOverride` interface replace the standard behavior completely. However, overridden actions always display as a page, not as a panel. Your component displays without controls, except for the main Lightning Experience navigation bar. Your component is expected to provide a complete user interface for the action, including navigation or actions beyond the navigation bar.



One important difference from Visualforce that's worth noting is how components are added to the **Lightning component** menu. The **Visualforce page** menu lists pages that either use the standard controller for the specific object, or that don't use a standard controller at all. This filtering means that the menu options vary from object to object, and offer only pages that are specific to the object, or completely generic.

The **Lightning component** menu includes every component that implements the `lightning:actionOverride` interface. A component that implements `lightning:actionOverride` can't restrict an admin to overriding only certain actions, or only for certain objects. We recommend that your organization adopt processes and component naming conventions to ensure that components are used to override only the intended actions on intended objects. Even so, it's your responsibility as the component developer to ensure that components that implement the `lightning:actionOverride` interface gracefully respond to being used with any action on any object.

Access Current Record Details

Components you plan to use as action overrides usually need details about the object type they're working with, and often the ID of the current record. Your component can implement the following interfaces to access those object and record details.

force:hasRecordId

Add the `force:hasRecordId` interface to an Aura component to enable the component to be assigned the ID of the current record. The current record ID is useful if the component is used on a Lightning record page, as an object-specific custom action or action override in Lightning Experience or the Salesforce app, and so on.

force:hasSObjectName

Add the `force:hasSObjectName` interface to an Aura component to enable the component to be assigned the API name of current record's `sObject` type. The `sObject` name is useful if the component can be used with records of different `sObject` types, and needs to adapt to the specific type of the current record.



Note: As of Spring '19 (API version 45.0), you can build Lightning components using two programming models: the Lightning Web Components model, and the original Aura Components model. Lightning web components are custom HTML elements built using HTML and modern JavaScript. Lightning web components and Aura components can coexist and interoperate on a page. As of API version 45.0, when we say Lightning components, we mean both Aura components and Lightning web components.

Packaging Action Overrides

Action overrides for custom objects are automatically packaged with the custom object. Action overrides for standard objects can't be packaged.

When you package a custom object, overrides on that object's standard actions are packaged with it. This includes any Lightning components used by the overrides. Your experience should be "it just works."

However, standard objects can't be packaged. As a consequence, there's no way to package overrides on the object's standard actions.

To override standard actions on standard objects in a package, do the following:

- Manually package any Lightning components that are used by the overrides.
- Provide instructions for subscribing orgs to manually override the relevant standard actions on the affected standard objects.

SEE ALSO:

[Override a Standard Action with an Aura Component](#)

[Metadata API Developer Guide : ActionOverride](#)

Navigate Across Your Apps with Page References

The `pageReference` JavaScript object represents a URL for a page. You can use a `pageReference` instead of parsing or creating a URL directly. This approach helps you avoid broken navigation if Salesforce changes URL formats in the future.

These navigation resources are supported only in Lightning Experience, Lightning Communities, and the Salesforce mobile app. They're not supported in other containers, such as Lightning Components for Visualforce, or Lightning Out. This is true even if you access these containers inside Lightning Experience or the Salesforce mobile app.

Use the following resources to simplify navigation across your apps. URLs for components using these resources are case-sensitive. For examples, see the [Component Library](#).

lightning:navigation

To navigate to a page or component, use the `navigate()` method in `lightning:navigation`. This approach is a substitute for a `navigateTo*` event, and both are supported.

To generate a URL in your component, use the `generateUrl()` method in `lightning:navigation` to resolve the URL.

 **Note:** `generateUrl()` returns a promise, which calls back with the resulting URL.

lightning:isUrlAddressable

To enable a component to navigate directly via a URL, add the `lightning:isUrlAddressable` interface to your component.



Tip: `pageReference` and `lightning:isUrlAddressable` replace the `force:navigateToComponent` event for navigating directly to a component. Unlike the `force:navigateToComponent` event information-mapping protocol, the only attribute populated through the navigation dispatching system is the `pageReference` attribute. Information is passed to the addressed component through the `state` properties on the target page reference. `lightning:isUrlAddressable` doesn't automatically set attributes on the target component. Get parameters from `v.pageReference.state` and manually set them using the target component's `init` handler.

`pageReference` provides a well-defined structure that describes the page type and its corresponding attributes. `pageReference` supports the following properties.

| Property | Type | Description | Required? |
|-------------------------|--------|--|-----------|
| <code>type</code> | String | The API name of the <code>pageReference</code> type, for example, <code>standard__objectPage</code> . | Y |
| <code>attributes</code> | Object | Values for each attribute specified by the page definition, for example, <code>objectAPIName</code> or <code>actionName</code> . | Y |

| Property | Type | Description | Required? |
|----------|--------|---|-----------|
| state | Object | Parameters that are tied to the query string of the URL in Lightning Experience, such as <code>filterName</code> . The routing framework doesn't depend on <code>state</code> to render a page. | |

A `pageReference` object contains key-value pairs to describe the `pageReference` type that you are navigating to. The `pageReference` looks like:

```
var pageReference = {
  type: 'standard__objectPage',
  attributes: {
    objectApiName: 'Account',
    actionName: 'list'
  },
  state: {
    filterName: 'MyAccounts'
  }
};
```

Because the key-value pairs of `pageReference.state` are serialized to URL query parameters, all its values are strings. Code that consumes values from the `state` must properly parse the value into the correct format. To delete a value from the `state` array, define it as `undefined`.

You can't directly change the `pageReference` object. To update the `state`, create a new `pageReference` object, and copy the values using `Object.assign()`.

If your component uses the `lightning:hasPageReference` or `lightning:isUrlAddressable` interfaces, always implement a change handler. When the target of a navigation action maps to the same component, the routing container might simply update the `pageReference` attribute value instead of recreating the component. In this scenario, a change handler ensures that your component reacts correctly.

`state` parameters must be namespaced. For example, a managed package with the namespace `abc` with a parameter `accountId` is represented as `abc__accountId`. The namespace for custom components is `c__`. Parameters without a namespace are reserved for Salesforce use. This namespace restriction is introduced under a critical update in Winter '19 and enforced in Summer '19.

Migrate to `lightning:isUrlAddressable` from `force:navigateToComponent`

If you're currently using the `force:navigateToComponent` event, you can provide backward compatibility for bookmarked links by redirecting requests to a component that uses `lightning:isUrlAddressable`.

First, copy your original component, including its definition, controller, helper, renderer, and CSS. Make the new component implement the `lightning:isUrlAddressable` interface.

Change the new component to read the values passed through the navigation request from `cmp.get("v.pageReference").state`.



Note: You can't use two-way binding to map values from `pageReference.state` to a subcomponent that sets those values. You can't modify the `state` object. As a workaround, copy the values from `pageReference.state` into your own component's attribute using a handler.

```
// Add a handler to your component
<aura:handler name="init" value="{!!this}" action="{!!c.init}" />

// Controller example
({
    init: function(cmp, event, helper) {
        var pageReference = cmp.get("v.pageReference");
        cmp.set("v.myAttr", pageReference.state.c__myAttr);
        // myAttr can be modified, but isn't reflected in the URL
    }
})
```

In the new component, remove the attributes mapped from the URL that aren't used to copy values from the page state in the component's `init` handler.

Change the instances that navigate to your old component to the new API and address of your new component. For example, remove instances of `force:navigateToComponent`, like

```
$A.get("e.force:navigateToComponent").setParams({componentDef: "c:oldCmp", attributes: {"myAttr": "foo"} }).fire();
```

Add `<lightning:navigation aura:id="navigationService" />` to your component markup, and update it to use `navigationService`. Pass in a `pageReference`.

```
cmp.find("navigationService").navigate({
    type: "standard__component",
    attributes: {
        name: "c:myCmpCopy" },
    state: { "c__myAttr": "foo" }});
```

In the original component's `init` handler, send a navigation redirect request to navigate to the new component. Pass the third argument in the `navigate` API call as `true`. This argument indicates that the request replaces the current entry in the browser history and avoids an extra entry when using a browser's navigation buttons.

```
({
    init: function(cmp, event, helper) {
        cmp.find("navigation").navigate({
            type: "standard__component",
            attributes: {
                componentName: "c__componentB" },
            state: {
                c__myAttr: cmp.get("v.myAttr")
            }
        }, true); // replace = true
    }
})
```

Remove all other code from the original component's definition, controller, helper, renderer, and CSS. Leave only the navigation redirect call.

Navigate to a Web Page

The navigation service supports different kinds of pages in Lightning. Each [page reference type](#) supports a different set of attributes and state properties.

Instead of using `force:navigateToURL`, we recommend navigating to web pages using the `lightning:navigate` component with the `standard__webPage` page type.

This code shows examples of navigating to a web page using the old `force:navigateToURL` event.

```
// Old way to navigate to a web page
$A.get("markup://force:navigateToURL").setParams({
    url: 'http://salesforce.com',
}).fire();
```

Replace the previous code that uses `force:navigateToURL` with the following code. This example shows how to navigate to a web page using the `standard__webPage` page type. It assumes that you added `<lightning:navigation aura:id="navigationService" />` in your component markup.

```
cmp.find("navigationService").navigate({
    type: "standard__webPage",
    attributes: {
        url: 'http://salesforce.com'
    }
});
```

IN THIS SECTION:

[pageReference Types](#)

A `pageReference` must be defined with a specific type. The type generates a unique URL format and provides attributes that apply to all pages of that type.

[Add Links to Lightning Pages from Your Custom Components](#)

To link to Lightning Experience pages, use `lightning:formattedUrl` in your custom component.

The `lightning:formattedUrl` component displays a URL as a hyperlink.

pageReference Types

A `pageReference` must be defined with a specific type. The type generates a unique URL format and provides attributes that apply to all pages of that type.

The following types are supported.

- Lightning Component (must implement `lightning:isUrlAddressable`)
- Knowledge Article
- Named Page
- Navigation Item Page
- Object Page
- Record Page
- Record Relationship Page
- Web Page

Lightning Component Type

A Lightning component that implements the `lightning:isUrlAddressable` interface, which enables the component to be navigated directly via URL.

Type

```
standard__component
```

Type Attributes

| Property | Type | Description | Required? |
|----------------------------|--------|--|-----------|
| <code>componentName</code> | String | The Lightning component name in the format <code>namespace__componentName</code> . | Y |

Example

```
{
  "type": "standard__component",
  "attributes": {
    "componentName": "c__MyLightningComponent"
  },
  "state": {
    "myAttr": "attrValue"
  }
}
```

URL Format

```
/cmp/{componentName}?myAttr=attrValue
```

Knowledge Article Page Type

A page that interacts with a Knowledge Article record.

Type

```
standard__knowledgeArticlePage
```

Type Attributes

| Property | Type | Description | Required? |
|--------------------------|--------|---|-----------|
| <code>articleType</code> | String | The <code>ArticleType</code> API name of the Knowledge Article record. | Y |
| <code>urlName</code> | String | The value of the <code>urlName</code> field on the target <code>KnowledgeArticleVersion</code> record. The <code>urlName</code> is the article's URL. | Y |

Example

```
{
  "type": "standard__knowledgeArticlePage",
  "attributes": {
```

```

        "articleType": "Briefings",
        "urlName": "February-2017"
    }
}

```

URL Format

```
/articles/{articleType}/{urlName}
```

Named Page Type

A standard page with a unique name. Only `home`, `chatter`, `today`, and `dataAssessment` are supported.

Type

```
standard__namedPage
```

Type Attributes

| Property | Type | Description | Required? |
|----------|--------|------------------------------|-----------|
| pageName | String | The unique name of the page. | Y |

Example

```
{
    "type": "standard__namedPage",
    "attributes": {
        "pageName": "home"
    }
}
```

URL Format

```
/page/{pageName}
```

Navigation Item Page Type

A page that displays the content mapped to a CustomTab. Visualforce tabs, Web tabs, Lightning Pages, and Lightning Component tabs are supported.

Type

```
standard__navItemPage
```

Type Attributes

| Property | Type | Description | Required? |
|----------|--------|-----------------------------------|-----------|
| apiName | String | The unique name of the CustomTab. | Y |

Example

```
{
  "type": "standard__navItemPage",
  "attributes": {
    "apiName": "MyCustomTabName"
  }
}
```

URL Format

```
/n/{devName}
```

Object Page Type

A page that interacts with a standard or custom object in the org and supports standard actions for that object.



Note: The `standard__objectPage` type replaces the `force:navigateToObjectHome` and the `force:navigateToList` events.

Type

```
standard__objectPage
```

Type Attributes

| Property | Type | Description | Required? |
|---------------|--------|---|-----------|
| actionName | String | The action name to invoke. Valid values include <code>home</code> , <code>list</code> , and <code>new</code> . | Y |
| objectApiName | String | The API name of the standard or custom object. For custom objects that are part of a managed package, prefix the custom object with <code>ns__</code> . | Y |

Standard Object Example

```
{
  "type": "standard__objectPage",
  "attributes": {
    "objectApiName": "Case",
    "actionName": "home"
  }
}
```

```
{
  type: "standard__objectPage",
  attributes: {
    objectApiName: "Account",
    actionName: "list"
  },
  state: {
    filterName: "Recent"
  }
}
```

Navigate to a Specific List View Example

```
{
  "type": "standard__objectPage",
  "attributes": {
    "objectApiName": "ns__Widget__c",
    "actionName": "list"
  },
  "state": {
    "filterName": "Recent"
  }
}
```

URL Format

```
/o/{objectApiName}/{actionName}
/o/{objectApiName}/{actionName}?filterName=Recent
```

Record Page Type

A page that interacts with a record in the org and supports standard actions for that record.

 **Note:** The `standard__recordPage` type replaces the `force:navigateToSObject` event.

Type

```
standard__recordPage
```

Type Attributes

| Property | Type | Description | Required? |
|---------------|--------|--|-----------|
| actionName | String | The action name to invoke. Valid values include <code>clone</code> , <code>edit</code> , and <code>view</code> . | Y |
| objectApiName | String | The API name of the record's object. Optional for lookups. | |
| recordId | String | The 18 character record ID. | Y |

Example

```
{
  "type": "standard__recordPage",
  "attributes": {
    "recordId": "001xx000003DGg0AAG",
    "objectApiName": "PersonAccount",
    "actionName": "view"
  }
}
```

URL Format

```
/r/{objectApiName}/{recordId}/{actionName}
/r/{recordId}/{actionName}
```

Record Relationship Page Type

A page that interacts with a relationship on a particular record in the org. Only related lists are supported.

 **Note:** The standard __ recordRelationshipPage type replaces the force:navigateToRelatedList event.

Type

```
standard__recordRelationshipPage
```

Type Attributes

| Property | Type | Description | Required? |
|---------------------|--------|---|-----------|
| actionName | String | The action name to invoke. Only view is supported. | Y |
| objectApiName | String | The API name of the object that defines the relationship. Optional for lookups. | |
| recordId | String | The 18 character record ID of the record that defines the relationship. | Y |
| relationshipApiName | String | The API name of the object's relationship field | |

Example

```
{
  "type": "standard__recordRelationshipPage",
  "attributes": {
    "recordId": "500xx000000Ykt4AAC",
    "objectApiName": "Case",
    "relationshipApiName": "CaseComments",
    "actionName": "view"
  }
}
```

URL Format

```
/r/{objectApiName}/{recordId}/related/{relationshipApiName}/{actionName}
/r/{recordId}/related/{relationshipApiName}/{actionName}
```

Web Page

An external URL.

 **Note:** The standard __ webPage type replaces the force:navigateToURL event.

Type

```
standard__webPage
```

Attributes

| Property | Type | Description | Required |
|----------|--------|--|----------|
| url | String | The URL of the page you are navigating to. | Yes |

Example

```
{
  "type": "standard_webPage",
  "attributes": {
    "url": "http://salesforce.com"
  }
},
{
  replace: true
}
```

To replace the current page with this URL in your browser's session history, set `replace` to `true`. The current page is not saved in session history, meaning the user can't navigate back to it. The `replace` attribute is ignored for external links.

URL Format

A web page opens as is in a new tab, so it doesn't have a URL format.

Add Links to Lightning Pages from Your Custom Components

To link to Lightning Experience pages, use `lightning:formattedUrl` in your custom component.

The `lightning:formattedUrl` component displays a URL as a hyperlink.

If you use raw anchor tags or the `ui:outputUrl` component for links, the page does a full reload each time you click the link. To avoid full page reloads, replace your link components with `lightning:formattedUrl`.

For examples, see the [Component Library](#).

Migrate from `ui:outputUrl` to `lightning:formattedUrl`

Copy the attributes from the `ui:outputUrl` component.

```
<aura:component>
  <ui:outputURL value="https://my/path" label="Contact ID" />
</aura:component>
```

Paste the same attributes into the `lightning:formattedUrl` component. `lightning:formattedUrl` supports more attributes, like `tooltip`.

```
<aura:component>
  <div aura:id="container">
    <p><lightning:formattedUrl value="https://my/path" label="Contact ID" tooltip="Go to Contact's recordId" /></p>
  </div>
</aura:component>
```

SEE ALSO:

[Component Library: lightning:formattedUrl Reference](#)

Get Your Aura Components Ready to Use on Lightning Pages

Custom Aura components don't work on Lightning pages or in the Lightning App Builder right out of the box. To use a custom component in either of these places, configure the component and its component bundle so that they're compatible.

IN THIS SECTION:

[Configure Components for Lightning Pages and the Lightning App Builder](#)

There are a few steps to take before you can use your custom Aura components in either Lightning pages or the Lightning App Builder.

[Configure Components for Lightning Experience Record Pages](#)

After your component is set up to work on Lightning pages and in the Lightning App Builder, use these guidelines to configure the component so it works on record pages in Lightning Experience.

[Create Components for the Outlook and Gmail Integrations](#)

Create custom Aura components that are available to add to the email application pane for the Outlook and Gmail integrations.

[Create Dynamic Picklists for Your Custom Components](#)

You can expose a component property as a picklist when the component is configured in the Lightning App Builder. The picklist's values are provided by an Apex class that you create.

[Create a Custom Lightning Page Template Component](#)

Every standard Lightning page is associated with a default template component, which defines the page's regions and what components the page includes. Custom Lightning page template components let you create page templates to fit your business needs with the structure and components that you define. Once implemented, your custom template is available in the Lightning App Builder's new page wizard for your page creators to use.

[Lightning Page Template Component Best Practices](#)

Keep these best practices and limitations in mind when creating Lightning page template components.

[Make Your Lightning Page Components Width-Aware with lightning:flexipageRegionInfo](#)

When you add a component to a region on a page in the Lightning App Builder, the `lightning:flexipageRegionInfo` sub-component passes the width of that region to its parent component. With `lightning:flexipageRegionInfo` and some strategic CSS, you can tell the parent component to render in different ways in different regions at runtime.

[Tips and Considerations for Configuring Components for Lightning Pages and the Lightning App Builder](#)

Keep these guidelines in mind when creating components and component bundles for Lightning pages and the Lightning App Builder.

Configure Components for Lightning Pages and the Lightning App Builder

There are a few steps to take before you can use your custom Aura components in either Lightning pages or the Lightning App Builder.

1. Deploy My Domain in Your Org

Deploy My Domain in your org if you want to use Aura components in Lightning tabs, Lightning pages, as custom Lightning page templates, or as standalone apps.

For more information about My Domain, see [Salesforce Help](#).

2. Add a New Interface to Your Component

To appear in the Lightning App Builder or on a Lightning page, a component must implement one of these interfaces.

| Interface | Description |
|---|--|
| <code>flexipage:availableForAllPageTypes</code> | Makes your component available for record pages and any other type of page, including a Lightning app's utility bar. |
| <code>flexipage:availableForRecordHome</code> | If your component is designed for record pages only, implement this interface instead of <code>flexipage:availableForAllPageTypes</code> . |
| <code>clients:availableForMailAppAppPage</code> | Enables your component to appear on a Mail App Lightning page in the Lightning App Builder and in the Outlook and Gmail integrations. |

Here's the sample code for a simple "Hello World" component.

```
<aura:component implements="flexipage:availableForAllPageTypes" access="global">
    <aura:attribute name="greeting" type="String" default="Hello" access="global" />
    <aura:attribute name="subject" type="String" default="World" access="global" />

    <div style="box">
        <span class="greeting">{!v.greeting}</span>, {!v.subject}!
    </div>
</aura:component>
```

 **Note:** Mark your resources, such as a component, with `access="global"` to make the resource usable outside of your own org. For example, if you want a component to be usable in an installed package or by a Lightning App Builder user or a Community Builder user in another org.

3. Add a Design Resource to Your Component Bundle

Use a design resource to control which attributes are exposed to builder tools like the Lightning App Builder, Community Builder, or Flow Builder. A design resource lives in the same folder as your .cmp resource, and describes the design-time behavior of the Aura component—information that visual tools need to display the component in a page or app.

For example, if you want to restrict a component to one or more objects, set a default value on an attribute, or make an Aura component attribute available for administrators to edit in the Lightning App Builder, you need a design resource in your component bundle.

Here's the design resource that goes in the bundle with the "Hello World" component.

```
<design:component label="Hello World">
    <design:attribute name="subject" label="Subject" description="Name of the person you want to greet" />
    <design:attribute name="greeting" label="Greeting" />
</design:component>
```

Design resources must be named `componentName.design`.

Optional: Add an SVG Resource to Your Component Bundle

You can use an SVG resource to define a custom icon for your component when it appears in the Lightning App Builder's component pane. Include it in the component bundle.

Here's a simple red circle SVG resource to go with the "Hello World" component.

```
<?xml version="1.0"?>
<!DOCTYPE svg PUBLIC "-//W3C//DTD SVG 1.1//EN"
"http://www.w3.org/Graphics/SVG/1.1/DTD/svg11.dtd">

<svg xmlns="http://www.w3.org/2000/svg"
width="400" height="400">
  <circle cx="100" cy="100" r="50" stroke="black"
  stroke-width="5" fill="red" />
</svg>
```

SVG resources must be named `componentName.svg`.

SEE ALSO:

[Aura Component Bundle Design Resources](#)

[Tips and Considerations for Configuring Components for Lightning Pages and the Lightning App Builder](#)

[Component Bundles](#)

Configure Components for Lightning Experience Record Pages

After your component is set up to work on Lightning pages and in the Lightning App Builder, use these guidelines to configure the component so it works on record pages in Lightning Experience.

Record pages are different from app pages in a key way: they have the context of a record. To make your components display content that is based on the current record, use a combination of an interface and an attribute.

- If your component is available for both record pages and any other type of page, implement `flexipage:availableForAllPageTypes`.
- If your component is designed only for record pages, implement the `flexipage:availableForRecordHome` interface instead of `flexipage:availableForAllPageTypes`.
- If your component needs the record ID, also implement the `force:hasRecordId` interface.

 **Note:** Don't expose the `recordId` attribute to the Lightning App Builder—don't put it in the component's design resource. You don't want admins supplying a record ID.

- If your component needs the object's API name, also implement the `force:hasObjectName` interface.

 **Note:** If your managed component implements the `flexipage` or `forceCommunity` interfaces, its upload is blocked if the component and its attributes aren't set to `access="global"`. For more information on access checks, see [Controlling Access](#).



Note: When you use the Lightning App Builder, there is a known limitation when you edit a group page. Your changes appear when you visit the group from the Groups tab. Your changes don't appear when you visit the group from the Recent Groups list on the Chatter tab.

SEE ALSO:

[Configure Components for Lightning Pages and the Lightning App Builder](#)

[Tips and Considerations for Configuring Components for Lightning Pages and the Lightning App Builder](#)

[Working with Salesforce Records](#)

Create Components for the Outlook and Gmail Integrations

Create custom Aura components that are available to add to the email application pane for the Outlook and Gmail integrations.

To add a component to email application panes in the Outlook or Gmail integration, implement the `clients:availableForMailAppAppPage` interface.

To allow the component access to email or calendar events, implement the `clients:hasItemContext` interface.

The `clients:hasItemContext` interface adds attributes to your component that it can use to implement record- or context-specific logic. The attributes included are:

- The `source` attribute, which indicates the email or appointment source. Possible values include `email` and `event`.

```
<aura:attribute name="source" type="String" />
```

- The `mode` attribute, which indicates viewing or composing an email or event. Possible values include `view` and `edit`.

```
<aura:attribute name="mode" type="String" />
```

- The `people` attribute indicates recipients' email addresses on the current email or appointment.

```
<aura:attribute name="people" type="Object" />
```

The shape of the `people` attribute changes according to the value of the `source` attribute.

When the `source` attribute is set to `email`, the `people` object contains the following elements.

```
{
    to: [ { name: nameString, email: emailString }, ... ],
    cc: [ ... ],
    from: [ { name: senderName, email: senderEmail } ],
}
```

When the `source` attribute is set to `event`, the `people` object contains the following elements.

```
{
    requiredAttendees: [ { name: attendeeNameString, email: emailString }, ... ],
    optionalAttendees: [ { name: optAttendeenameString, email: emailString }, ... ],
    organizer: [ { name: organizerName, email: senderEmail } ],
}
```

- The `subject` indicates the subject on the current email.

```
<aura:attribute name="subject" type="String" />
```

- The `messageBody` indicates the email message on the current email.

```
<aura:attribute name="messageBody" type="String" />
```

To provide the component with an event's date or location, implement the `clients:hasEventContext` interface.

```
dates: {
    "start": value (String),
    "end": value (String),
}
```

The Outlook and Gmail integrations don't support the following events:

- `force:navigateToList`
- `force:navigateToRelatedList`
- `force:navigateToObjectHome`
- `force:refreshView`

 **Note:** To ensure that custom components appear correctly, enable them to adjust to variable widths.

IN THIS SECTION:

[Sample Custom Components for Outlook and Gmail Integration](#)

Review samples of custom Aura components that you can implement in the email application pane for Outlook integration and Gmail Integration.

Sample Custom Components for Outlook and Gmail Integration

Review samples of custom Aura components that you can implement in the email application pane for Outlook integration and Gmail Integration.

Here's an example of a custom Aura component you can include in your email application pane for the Outlook or Gmail integration. This component applies the context of the selected email or appointment.

```
<aura:component implements="clients:availableForMailAppAppPage,clients:hasItemContext">

<!--
    Add these handlers to customize what happens when the attributes change
    <aura:handler name="change" value="{!v.subject}" action="{!!c.handleSubjectChange}" />

    <aura:handler name="change" value="{!v.people}" action="{!!c.handlePeopleChange}" />
-->

<div id="content">
    <aura:if isTrue="={!v.mode == 'edit'}">
        You are composing the following Item: <br/>
        <aura:set attribute="else">
            You are reading the following Item: <br/>
        </aura:set>
    </aura:if>

    <h1><b>Email subject</b></h1>
    <span id="subject">{!v.subject}</span>

```

```

<h1>To:</h1>
<aura:iteration items="{!v.people.to}" var="to">
    {!to.name} - {!to.email} <br/>
</aura:iteration>

<h1>From:</h1>
{!v.people.from.name} - {!v.people.from.email}

<h1>CC:</h1>
<aura:iteration items="{!v.people.cc}" var="cc">
    {!cc.name} - {!cc.email} <br/>
</aura:iteration>

<span class="greeting">New Email Arrived</span>, {!v.subject}!
</div>
</aura:component>

```

In this example, the custom component displays account and opportunity information based on the email recipients' email addresses. The component calls a JavaScript controller function, `handlePeopleChange()`, on initialization. The JavaScript controller calls methods on an Apex server-side controller to query the information and compute the accounts ages and opportunities days until closing. The Apex controller, JavaScript controller, and helper are listed next.

```

<!--
This component handles the email context on initialization.
It retrieves accounts and opportunities based on the email addresses included
in the email recipients list.
It then calculates the account and opportunity ages based on when the accounts
were created and when the opportunities will close.
-->

<aura:component
    implements="clients:availableForMailAppAppPage,clients:hasItemContext"
    controller="ComponentController">

    <aura:handler name="init" value="{!this}" action=" {!c.handlePeopleChange}" />
    <aura:attribute name="accounts" type="List" />
    <aura:attribute name="opportunities" type="List" />
    <aura:iteration items="{!v.accounts}" var="acc">
        {!acc.name} => {!acc.age}
    </aura:iteration>
    <aura:iteration items="{!v.opportunities}" var="opp">
        {!opp.name} => {!opp.closesIn} Days till closing
    </aura:iteration>

```

</aura:component>

```

/*
On the server side, the Apex controller includes
Aura-enabled methods that accept a list of emails as parameters.
*/

```

`public class ComponentController {`

```

/*
This method searches for Contacts with matching emails in the email list,
and includes Account information in the fields. Then, it filters the
information to return a list of objects to use on the client side.
*/
@AuraEnabled
public static List<Map<String, Object>> findAccountAges(List<String> emails) {
    List<Map<String, Object>> ret = new List<Map<String, Object>>();
    List<Contact> contacts = [SELECT Name, Account.Name, Account.CreatedDate
                                FROM Contact
                                WHERE Contact.Email IN :emails];
    for (Contact c: contacts) {
        Map<String, Object> item = new Map<String, Object>();
        item.put('name', c.Account.Name);
        item.put('age',
                Date.valueOf(c.Account.CreatedDate).daysBetween(
                    System.Date.today()));
        ret.add(item);
    }
    return ret;
}

/*
This method searches for OpportunityContactRoles with matching emails
in the email list.
Then, it calculates the number of days until closing to return a list
of objects to use on the client side.
*/
@AuraEnabled
public static List<Map<String, Object>> findOpportunityCloseDateTime(List<String>
emails) {
    List<Map<String, Object>> ret = new List<Map<String, Object>>();
    List<OpportunityContactRole> contacts =
        [SELECT Opportunity.Name, Opportunity.CloseDate
         FROM OpportunityContactRole
         WHERE isPrimary=true AND Contact.Email IN :emails];
    for (OpportunityContactRole c: contacts) {
        Map<String, Object> item = new Map<String, Object>();
        item.put('name', c.Opportunity.Name);
        item.put('closesIn',
                System.Date.today().daysBetween(
                    Date.valueOf(c.Opportunity.CloseDate)));
        ret.add(item);
    }
    return ret;
}
}

```

```

({
/*
This JavaScript controller is called on component initialization and relies
on the helper functionality to build a list of email addresses from the

```

available people. It then makes a call to the server to run the actions to display information.

Once the server returns the values, it sets the appropriate values to display on the client side.

```

*/
handlePeopleChange: function(component, event, helper){
    var people = component.get("v.people");
    var peopleEmails = helper.filterEmails(people);
    var action = component.get("c.findOpportunityCloseDateTime");
    action.setParam("emails", peopleEmails);

    action.setCallback(this, function(response) {
        var state = response.getState();
        if(state === "SUCCESS"){
            component.set("v.opportunities", response.getReturnValue());
        } else{
            component.set("v.opportunities", []);
        }
    });
    $A.enqueueAction(action);
    var action = component.get("c.findAccountAges");
    action.setParam("emails", peopleEmails);

    action.setCallback(this, function(response) {
        var state = response.getState();
        if(state === "SUCCESS"){
            component.set("v.accounts", response.getReturnValue());
        } else{
            component.set("v.accounts", []);
        }
    });
    $A.enqueueAction(action);
}
})

```

```
{
/*
This helper function filters emails from objects.
*/
filterEmails : function(people){
    return this.getEmailsFromList(people.to).concat(
        this.getEmailsFromList(people.cc));
},
getEmailsFromList : function(list){
    var ret = [];
    for (var i in list) {
        ret.push(list[i].email);
    }
    return ret;
}
})
```

Create Dynamic Picklists for Your Custom Components

You can expose a component property as a picklist when the component is configured in the Lightning App Builder. The picklist's values are provided by an Apex class that you create.

For example, let's say you're creating a component for the Home page to display a custom Company Announcement record. You can use an Apex class to put the titles of all Company Announcement records in a picklist in the component's properties in the Lightning App Builder. Then, when admins add the component to a Home page, they can easily select the appropriate announcement to place on the page.

1. Create a custom Apex class to use as a datasource for the picklist. The Apex class must extend the `VisualEditor.DynamicPickList` abstract class.
2. Add an attribute to your design file that specifies your custom Apex class as the datasource.

Here's a simple example.

Create an Apex Class

```
global class MyCustomPickList extends VisualEditor.DynamicPickList{  
  
    global override VisualEditor.DataRow getDefaultValue(){  
        VisualEditor.DataRow defaultValue = new VisualEditor.DataRow('red', 'RED');  
        return defaultValue;  
    }  
    global override VisualEditor.DynamicPickListRows getValues() {  
        VisualEditor.DataRow value1 = new VisualEditor.DataRow('red', 'RED');  
        VisualEditor.DataRow value2 = new VisualEditor.DataRow('yellow', 'YELLOW');  
        VisualEditor.DynamicPickListRows myValues = new VisualEditor.DynamicPickListRows();  
  
        myValues.addRow(value1);  
        myValues.addRow(value2);  
        return myValues;  
    }  
}
```



Note: Although `VisualEditor.DataRow` allows you to specify any Object as its value, you can specify a datasource only for String attributes. The default implementation for `isValid()` and `getLabel()` assumes that the object passed in the parameter is a String for comparison.

For more information on the `VisualEditor.DynamicPickList` abstract class, see the [Apex Developer Guide](#).

Add the Apex Class to Your Design File

To specify an Apex class as a datasource in an existing component, add the datasource property to the attribute with a value consisting of the Apex namespace and Apex class name.

```
<design:component>  
    <design:attribute name="property1" datasource="apex://MyCustomPickList"/>  
</design:component>
```

Dynamic Picklist Considerations

- Specifying the Apex datasource as public isn't respected in managed packages. If an Apex class is public and part of a managed package, it can be used as a datasource for custom components in the subscriber org.
- Profile access on the Apex class isn't respected when the Apex class is used as a datasource. If an admin's profile doesn't have access to the Apex class but does have access to the custom component, the admin sees values provided by the Apex class on the component in the Lightning App Builder.

Create a Custom Lightning Page Template Component

Every standard Lightning page is associated with a default template component, which defines the page's regions and what components the page includes. Custom Lightning page template components let you create page templates to fit your business needs with the structure and components that you define. Once implemented, your custom template is available in the Lightning App Builder's new page wizard for your page creators to use.

 **Note:** My Domain must be enabled in your org before you can use custom template components in the Lightning App Builder.

Custom Lightning page template components are supported for record pages, app pages, and Home pages. Each page type has a different interface that the template component must implement.

- lightning:appHomeTemplate
- lightning:homeTemplate
- lightning:recordHomeTemplate

 **Important:** Each template component should implement only one template interface. Template components shouldn't implement any other type of interface, such as flexipage:availableForAllPageTypes or force:hasRecordId. A template component can't multi-task as a regular component. It's either a template, or it's not.

1. Build the Template Component Structure

A custom template is an Aura component bundle that should include at least a .cmp resource and a design resource. The .cmp resource must implement a template interface, and declare an attribute of type `Aura.Component []` for each template region. The `Aura.Component []` type defines the attribute as a collection of components.

 **Note:** The `Aura.Component []` attribute is interpreted as a region only if it's also specified as a region in the design resource.

Here's an example of a two-column app page template .cmp resource that uses the `lightning:layout` component and the Salesforce Lightning Design System (SLDS) for styling.

When the template is viewed on a desktop, its right column takes up 30% (4 SLDS columns). The left column takes up the remaining 70% of the page width. On non-desktop form factors, the columns display as 50/50.

```
<aura:component implements="lightning:appHomeTemplate" description="Main column and right sidebar. On a phone, the regions are of equal width">
    <aura:attribute name="left" type="Aura.Component[]" />
    <aura:attribute name="right" type="Aura.Component[]" />

    <div>
        <lightning:layout>
            <lightning:layoutItem flexibility="grow"
                class="slds-m-right_small">
                {!v.left}
            </lightning:layoutItem>
        </lightning:layout>
    </div>
</aura:component>
```

```

<lightning:layoutItem size="{! $Browser.isDesktop ? '4' : '6' }"
    class="slds-m-left_small">
    {!v.right}
</lightning:layoutItem>
</lightning:layout>
</div>

</aura:component>

```

The `description` attribute on the `aura:component` tag is optional, but recommended. If you define a description, it displays as the template description beneath the template image in the Lightning App Builder new page wizard.

2. Configure Template Regions and Components in the Design Resource

The design resource controls what kind of page can be built on the template. The design resource specifies what regions a page that uses the template must have. It also specifies what kinds of components can be put into those regions.

Regions inherit the interface assignments that you set for the overall page, as set in the .cmp resource.

Specify regions and components using these tags:

flexipage:template

This tag has no attributes and acts as a wrapper for the `flexipage:region` tag. Text literals are not allowed.

flexipage:region

This tag defines a region on the template and has these attributes. Text literals are not allowed.

| Attribute | Description |
|---------------------------|--|
| <code>name</code> | The name of an attribute in the .cmp resource marked type <code>Aura.Component[]</code> . Flags the attribute as a region. |
| <code>label</code> | The label of your region. This label appears in the template switching wizard in the Lightning App Builder when users map region content to a new template. |
| <code>defaultWidth</code> | Specifies the default width of the region. This attribute is required for all regions. Valid values are: <code>Small</code> , <code>Medium</code> , <code>Large</code> , and <code>Xlarge</code> . |

flexipage:formFactor

Use this tag to specify how much space the component takes on the page based on the type of device that it renders on. Add this tag as a child of the `flexipage:region` tag. Use multiple `flexipage:formFactor` tags per `flexipage:region` to define flexible behavior across form factors.

| Attribute | Description |
|--------------------|--|
| <code>type</code> | The type of form factor or device the template renders on, such as a desktop or tablet. Valid values are: <code>Medium</code> (tablet), and <code>Large</code> (desktop). Because the only reasonable width value for a <code>Small</code> form factor (phone) is <code>Small</code> , you don't have to specify a <code>Small</code> type. Salesforce takes care of that association automatically. |
| <code>width</code> | The available size of the area that the component in this region has to render in. Valid values are: <code>Small</code> , <code>Medium</code> , <code>Large</code> , and <code>Xlarge</code> . |

For example, in this code snippet, the region has a large width to render in when the template is rendered on a large form factor. The region has a small width to render in when the template is rendered on a medium form factor.

```
<flexipage:region name="right" label="Right Region" defaultWidth="Large">
  <flexipage:formFactor type="Large" width="Large" />
  <flexipage:formFactor type="Medium" width="Small" />
</flexipage:region>
```



Tip: You can use the `lightning:flexipageRegionInfo` subcomponent to pass region width information to a component. Doing so lets you configure your page components to render differently based on what size region they display in.

Here's the design file that goes with the sample .cmp resource. The label text in the design file displays as the name of the template in the new page wizard.

```
<design:component label="Two Region Custom App Page Template">
  <flexipage:template>
    <!-- The default width for the "left" region is "MEDIUM". In tablets, the width is "SMALL" -->
    <flexipage:region name="left" label="Left Region" defaultWidth="MEDIUM">
      <flexipage:formfactor type="MEDIUM" width="SMALL" />
    </flexipage:region>
    <flexipage:region name="right" label="Right Region" defaultWidth="SMALL" />
  </flexipage:template>
</design:component>
```

3. (Optional) Add a Template Image

If you added a description to your .cmp resource, both it and the template image display when a user selects your template in the Lightning App Builder new page wizard.

You can use an SVG resource to define the custom template image.



We recommend that your SVG resource is no larger than 150 KB, and no more than 160 px high and 560 px wide.

SEE ALSO:

[Lightning Page Template Component Best Practices](#)

[Make Your Lightning Page Components Width-Aware with lightning:flexipageRegionInfo](#)

Lightning Page Template Component Best Practices

Keep these best practices and limitations in mind when creating Lightning page template components.

- Don't add custom background styling to a template component. It interferes with Salesforce's Lightning Experience page themes.
- Including scrolling regions in your template component can cause problems when you try to view it in the Lightning App Builder.
- Custom templates can't be extensible nor extended—you can't extend a template from anything else, nor can you extend other things from a template.
- Using getters to get the regions as variables works at design time but not at run time. Here's an example of what we mean.

```
<aura:component implements="lightning:appHomeTemplate">
    <aura:attribute name="region" type="Aura.Component[]" />
    <aura:handler name="init" value="{!this}" action=" {!c.init}" />

    <div>
        {!v.region}
    </div>

</aura:component>

{
    init : function(component, event, helper) {
        var region = cmp.get('v.region'); // This will fail at run time.
        ...
    }
}
```

- You can remove regions from a template if it's not being used by a Lightning page, and if it's not set to access=global. You can add regions at any time.
- A region can be used more than once in the code, but only one instance of the region should render at run time.
- A template component can contain up to 25 regions.
- The order that you list the regions in a page template is the order that the regions appear in when admins migrate region content using the template switching wizard in the Lightning App Builder. We recommend that you label the regions and list them in a logical order in your template, such as top to bottom or left to right.

Make Your Lightning Page Components Width-Aware with **lightning:flexipageRegionInfo**

When you add a component to a region on a page in the Lightning App Builder, the `lightning:flexipageRegionInfo` sub-component passes the width of that region to its parent component. With `lightning:flexipageRegionInfo` and some strategic CSS, you can tell the parent component to render in different ways in different regions at runtime.

For example, the List View component renders differently in a large region than it does in a small region as it's a width-aware component.

The screenshot shows a Salesforce Opportunity record for "Burlington Textiles Weaving Plant Generator". At the top, there are standard navigation buttons like Follow, New Case, New Note, and Clone. Below the header, there's a green progress bar with arrows and a button labeled "Closed Won". A blue button labeled "Change Closed Stage" is also present.

The main content area contains a component with a red border. This component has a title "My Opportunities" and a subtitle "3+ items · Sorted by Opportunity Name · Updated a few seconds ago". It includes a "New" button and filtering options. The list shows three opportunities:

| | OPPORTUNITY NAME | ACCOUNT NAME | AMOUNT |
|---|---|------------------------------------|--------------|
| 1 | Burlington Textiles Weaving Plant Generator | Burlington Textiles Corp of Ame... | \$235,000.00 |
| 2 | Dickenson Mobile Generators | Dickenson plc | \$15,000.00 |
| 3 | Edge Emergency Generator | Edge Communications | \$75,000.00 |

Below the list are tabs for DETAILS, ACTIVITY, RECENT ITEMS, and RELATED. The DETAILS tab is selected, showing the Opportunity Owner (Alex Rose), Amount (\$235,000.00), and Expected Revenue.

To the right of the component, there's a sidebar titled "My Opportunities" with a list of opportunities and their details:

- Burlington Textiles Weaving Plant Generator
 - Account Na... Burlington Textiles Corp of America
 - Amount: \$235,000.00
 - Close Date: 4/6/2017
 - Stage: Closed Won
 - Opportunity... AUUser
- Dickenson Mobile Generators
 - Account Na... Dickenson plc
 - Amount: \$15,000.00
 - Close Date: 12/15/2016
 - Stage: Qualification
 - Opportunity... AUUser

Valid region width values are: Small, Medium, Large, and Xlarge.

You can use CSS to style your component and to help determine how your component renders. Here's an example.

This simple component has two fields, field1 and field2. The component renders with the fields side by side, filling 50% of the region's available width when not in a small region. When the component is in a small region, the fields render as a list, using 100% of the region's width.

```
<aura:component implements="flexipage:availableForAllPageTypes">
<aura:attribute name="width" type="String"/>
<lightning:flexipageRegionInfo width="{!v.width}"/>
<div class="{' ! 'container' + (v.width=='SMALL'? 'narrowRegion':'') }">
    <div class="{' ! 'eachField f1' + (v.width=='SMALL'? 'narrowRegion':'') }">
        <lightning:input name="field1" label="First Name"/>
    </div>
    <div class="{' ! 'eachField f2' + (v.width=='SMALL'? 'narrowRegion':'') }">
        <lightning:input name="field2" label="Last Name"/>
    </div>
</div>
</aura:component>
```

Here's the CSS file that goes with the component.

```
.THIS .eachField.narrowRegion{
    width:100%;
}
.TTHIS .eachField{
    width:50%;
    display:inline-block;
}
```

Tips and Considerations for Configuring Components for Lightning Pages and the Lightning App Builder

Keep these guidelines in mind when creating components and component bundles for Lightning pages and the Lightning App Builder.



Note: Mark your resources, such as a component, with `access="global"` to make the resource usable outside of your own org. For example, if you want a component to be usable in an installed package or by a Lightning App Builder user or a Community Builder user in another org.

Components

- Set a friendly name for the component using the `label` attribute in the element in the design file, such as `<design:component label="foo">`.
- Make your components fill 100% of the width (including margins) of the region that they display in.
- Don't set absolute width values on your components.
- If components require interaction, they must provide an appropriate placeholder behavior in declarative tools.
- A component must never display a blank box. Think of how other sites work. For example, Facebook displays an outline of the feed before the actual feed items come back from the server. The outline improves the user's perception of UI responsiveness.
- If the component depends on a fired event, then give it a default state that displays before the event fires.
- Style components in a manner consistent with the styling of Lightning Experience and consistent with the Salesforce Design System.
- The Lightning App Builder manages spacing between components automatically. Don't add margins to your component CSS, and avoid adding padding.
- Don't use `float` or `position: absolute` in your CSS properties. These properties break the component out of the page structure and, as a result, break the page.
- If your org doesn't have My Domain enabled and you activate a Lightning page with a custom component, the component is dropped from the page at run time.

Attributes

- Use the design file to control which attributes are exposed to the Lightning App Builder.
- Make your attributes easy to use and understandable to an administrator. Don't expose SOQL queries, JSON objects, or Apex class names.
- Give your required attributes default values. When a component that has required attributes with no default values is added to the App Builder, it appears invalid, which is a poor user experience.
- Use basic supported types (string, integer, boolean) for any exposed attributes.
- Specify a min and max attribute for integer attributes in the `<design:attribute>` element to control the range of accepted values.
- String attributes can provide a data source with a set of predefined values allowing the attribute to expose its configuration as a picklist.
- Give all attributes a label with a friendly display name.
- Provide descriptions to explain the expected data and any guidelines, such as data format or expected range of values. Description text appears as a tooltip in the Property Editor.
- To delete a design attribute for a component that implements the `flexipage:availableForAllPageTypes` or `forceCommunity:availableForAllPageTypes` interface, first remove the interface from the component before

deleting the design attribute. Then reimplement the interface. If the component is referenced in a Lightning page, you must remove the component from the page before you can change it.

Limitations

- The Lightning App Builder doesn't support the Map, Object, or java:// complex types.
- When you use the Lightning App Builder, there is a known limitation when you edit a group page. Your changes appear when you visit the group from the Groups tab. Your changes don't appear when you visit the group from the Recent Groups list on the Chatter tab.

SEE ALSO:

[Configure Components for Lightning Pages and the Lightning App Builder](#)

[Configure Components for Lightning Experience Record Pages](#)

Use Aura Components in Community Builder

To use a custom Aura component in Community Builder, you must configure the component and its component bundle so that they're compatible.

IN THIS SECTION:

[Configure Components for Communities](#)

Make your custom Aura components available to drag to the Lightning Components pane in Community Builder.

[Create Custom Theme Layout Components for Communities](#)

Create a custom theme layout to transform the appearance and overall structure of the pages in the Customer Service template.

[Create Custom Component for Guest User Flows](#)

Allow flows for your community guest users to provide alternative user registration screens, complex decision trees, and conditional forms to gather user information. The following example uses the Site Class API. For more information, see "Site Class" in the Salesforce Apex Developer Guide.

[Create Custom Search and Profile Menu Components for Communities](#)

Create custom components to replace the Customer Service template's standard Profile Header and Search & Post Publisher components in Community Builder.

[Create Custom Content Layout Components for Communities](#)

Community Builder includes several ready-to-use layouts that define the content regions of your page, such as a two-column layout with a 2:1 ratio. However, if you need a layout that's customized for your community, create a custom content layout component to use when building new pages in Community Builder. You can also update the content layout of the default pages that come with your community template.

Configure Components for Communities

Make your custom Aura components available to drag to the Lightning Components pane in Community Builder.

Add a New Interface to Your Component

To appear in Community Builder, a component must implement the `forceCommunity:availableForAllPageTypes` interface.

Here's the sample code for a simple "Hello World" component.

```
<aura:component implements="forceCommunity:availableForAllPageTypes" access="global">
    <aura:attribute name="greeting" type="String" default="Hello" access="global" />
    <aura:attribute name="subject" type="String" default="World" access="global" />

    <div style="box">
        <span class="greeting">{!v.greeting}</span>, {!v.subject}!
    </div>
</aura:component>
```



Note: Mark your resources, such as a component, with `access="global"` to make the resource usable outside of your own org. For example, if you want a component to be usable in an installed package or by a Lightning App Builder user or a Community Builder user in another org.

Next, add a design resource to your component bundle. A design resource describes the design-time behavior of an Aura component—information that visual tools need to allow adding the component to a page or app. It contains attributes that are available for administrators to edit in Community Builder.

Adding this resource is similar to adding it for the Lightning App Builder. For more information, see [Configure Components for Lightning Pages and the Lightning App Builder](#).



Important: When you add custom components to your community, they can bypass the object- and field-level security (FLS) you set for the guest user profile. Lightning components don't automatically enforce [CRUD and FLS](#) when referencing objects or retrieving the objects from an Apex controller. This means that the framework continues to display records and fields for which users don't have CRUD permissions and FLS visibility. You *must* manually enforce CRUD and FLS in your Apex controllers.

SEE ALSO:

[Component Bundles](#)

[Standard Design Tokens for Communities](#)

Create Custom Theme Layout Components for Communities

Create a custom theme layout to transform the appearance and overall structure of the pages in the Customer Service template.

A theme layout component is the top-level layout for the template pages (1) in your community. Theme layout components are organized and applied to your pages through theme layouts. Theme layout components include the common header and footer (2), and often include navigation, search, and the user profile menu. In contrast, the content layout (3) defines the content regions of your pages, such as a two-column layout.



A theme layout type categorizes the pages in your community that share the same theme layout.

When you create a custom theme layout component in the Developer Console, it appears in Community Builder in the **Settings > Theme** area. Here you can assign it to new or existing theme layout types. Then you apply the theme layout type—and thereby the theme layout—in the page's properties.

1. Add an Interface to Your Theme Layout Component

A theme layout component must implement the `forceCommunity:themeLayout` interface to appear in Community Builder in the **Settings > Theme** area.

Explicitly declare `{ !v.body}` in your code to ensure that your theme layout includes the content layout. Add `{ !v.body}` wherever you want the page's contents to appear within the theme layout.

You can add components to the regions in your markup or leave regions open for users to drag-and-drop components into. Attributes declared as `Aura.Component[]` and included in your markup are rendered as open regions in the theme layout that users can add components to.

In Customer Service, the Template Header consists of these locked regions:

- `search`, which contains the Search Publisher component
- `profileMenu`, which contains the User Profile Menu component
- `navBar`, which contains the Navigation Menu component

To create a custom theme layout that reuses the existing components in the Template Header region, declare `search`, `profileMenu`, or `navBar` as the attribute name value, as appropriate. For example:

```
<aura:attribute name="navBar" type="Aura.Component[]" required="false" />
```



Tip: If you create a custom profile menu or a search component, declaring the attribute name value also lets users select the custom component when using your theme layout.

Here's the sample code for a simple theme layout.

```
<aura:component implements="forceCommunity:themeLayout" access="global" description="Sample  
Custom Theme Layout">  
    <aura:attribute name="search" type="Aura.Component[]" required="false"/>  
    <aura:attribute name="profileMenu" type="Aura.Component[]" required="false"/>
```

```

<aura:attribute name="navBar" type="Aura.Component[]" required="false"/>
<aura:attribute name="newHeader" type="Aura.Component[]" required="false"/>
<div>
    <div class="searchRegion">
        {!v.search}
    </div>
    <div class="profileMenuRegion">
        {!v.profileMenu}
    </div>
    <div class="navigation">
        {!v.navBar}
    </div>
    <div class="newHeader">
        {!v.newHeader}
    </div>
    <div class="mainContentArea">
        {!v.body}
    </div>
</div>
</aura:component>

```

 **Note:** Mark your resources, such as a component, with `access="global"` to make the resource usable outside of your own org. For example, if you want a component to be usable in an installed package or by a Lightning App Builder user or a Community Builder user in another org.

2. Add a Design Resource to Include Theme Properties

You can expose theme layout properties in Community Builder by adding a design resource to your bundle.

This example adds two checkboxes to a theme layout called Small Header.

```

<design:component label="Small Header">
    <design:attribute name="blueBackground" label="Blue Background"/>
    <design:attribute name="smallLogo" label="Small Logo"/>
</design:component>

```

The design resource only exposes the properties. You must implement the properties in the component.

```

<aura:component implements="forceCommunity:themeLayout" access="global" description="Small Header">
    <aura:attribute name="blueBackground" type="Boolean" default="false"/>
    <aura:attribute name="smallLogo" type="Boolean" default="false" />
    ...

```

Design resources must be named `componentName.design`.

3. Add a CSS Resource to Avoid Overlapping Issues

Add a CSS resource to your bundle to style the theme layout as needed.

To avoid overlapping issues with positioned elements, such as dialog boxes or hovers:

- Apply CSS styles.

```

.THIS {
    position: relative;

```

```

        z-index: 1;
    }
}

```

- Wrap the elements in your custom theme layout in a `div` tag.

```

<div class="mainContentArea">
    {!v.body}
</div>

```

 **Note:** For custom theme layouts, SLDS is loaded by default.

CSS resources must be named `componentName.css`.

SEE ALSO:

[Create Custom Search and Profile Menu Components for Communities](#)

[Salesforce Help: Custom Theme Layouts and Theme Layout Types](#)

Create Custom Component for Guest User Flows

Allow flows for your community guest users to provide alternative user registration screens, complex decision trees, and conditional forms to gather user information. The following example uses the Site Class API. For more information, see “Site Class” in the Salesforce Apex Developer Guide.

1. Create a Custom Aura Component

Using Guest User Flows for login or self registration requires a custom component that implements `lightning:availableForFlowScreens`.

Here's the sample code for a simple data collection preferences flow.

```

<aura:component implements="lightning:availableForFlowScreens"
controller="CommunitySelfRegController">
    <aura:attribute name="email" type="String" default="" />
    <aura:attribute name="fname" type="String" default="" />
    <aura:attribute name="lname" type="String" default="" />
    <aura:attribute name="starturl" type="String" default="" />
    <aura:attribute name="password" type="String" default="" />
    <aura:attribute name="hasOptedTracking" type="Boolean" default="false" />
    <aura:attribute name="hasOptedSolicit" type="Boolean" default="false" />
    <aura:attribute name="op_url" type="String" default="" description="login url after
user is created. " />

    <aura:handler name="init" value="{!this}" action=" {!c.init}" />

    <aura:if isTrue=" {! (empty(v.op_url)) }" >
        <!-- empty url, the user is not yet created -->
        <h3> Registering user. Please wait. </h3>

        <aura:set attribute="else">
            <!-- User created, show link to login -->
            <h3> Success! Your account has been created. </h3>
    
```

```

<button class="slds-button slds-button_neutral"
onclick="{!c.login}">Login</button>
</aura:set>
</aura:if>
</aura:component>

```

Controller file:

```

({
    init : function(cmp) {
        let email = cmp.get("v.email"),
            fname = cmp.get("v.fname"),
            lname = cmp.get("v.lname"),
            pass = cmp.get("v.password"),
            startUrl = cmp.get("v.starturl"),
            hasOptedSolicit = cmp.get("v.hasOptedSolicit"),
            hasOptedTracking = cmp.get("v.hasOptedTracking");

        let action = cmp.get("c.createExternalUser");
        action.setParams(
            {
                username: email,
                password: pass,
                startUrl: startUrl,
                fname: fname,
                lname: lname,
                hasOptedTracking: hasOptedTracking,
                hasOptedSolicit: hasOptedSolicit
            });
        action.setCallback(this, function(res) {
            if (action.getState() === "SUCCESS") {
                cmp.set("v.op_url", res.getReturnValue());
            }
        });
        $A.enqueueAction(action);
    },
    login: function(cmp){
        let url = cmp.get("v.op_url");
        window.location.href = url;
    }
})

```

Design file:

```

<design:component>
    <design:attribute name="email" />
    <design:attribute name="fname" />
    <design:attribute name="lname" />
    <design:attribute name="password" />
    <design:attribute name="hasOptedTracking" />
    <design:attribute name="hasOptedSolicit" />
</design:component>

```

2. Create an Apex Class

The following example creates a class, `CommunitySelfRegController`, which is used with your Aura component to register new community users.



Note: Adding self registration with a flow requires the following:

- The `UserPreferencesHideS1BrowserUI` preference should be set to True. This prevents the mobile UI from defaulting to the Salesforce Mobile App interface rather than your community.
- `CommunityNickname` is required and must be a unique value.
- The self registration preference should be enabled in your community with a valid profile and account.

```
public class CommunitySelfRegController {  
    @AuraEnabled  
    public static String createExternalUser(  
        String username, String password, String startUrl, String fname,  
        String lname, Boolean hasOptedTracking, Boolean hasOptedSolicit) {  
        Savepoint sp = null;  
        try {  
            sp = Database.setSavepoint();  
            system.debug(sp);  
  
            // Creating a user object.  
            User u = new User();  
            u.Username = username;  
            u.Email = username;  
            u.FirstName = fname;  
            u.LastName = lname;  
  
            // Default UI for mobile is set to S1 for user created using site object.  
  
            // Enable this perm to change it to community.  
            u.UserPreferencesHideS1BrowserUI = true;  
  
            // Generating unique value for community nickname.  
            String nickname = ((fname != null && fname.length() > 0) ? fname.substring(0,1) : ''  
                + lname.substring(0,1);  
            nickname += String.valueOf(Crypto.getRandomInteger()).substring(1,7);  
            u.CommunityNickname = nickname;  
  
            System.debug('creating user');  
  
            // Creating portal user.  
            // Passing in null account ID forces the system to read this from the  
            network setting (set using Community Workspaces).  
            String userId = Site.createPortalUser(u, null, password);  
  
            // Setting consent selection values.  
            // For this, GDPR (Individual and Consent Management) needs to be enabled  
            in the org.  
            Individual ind = new Individual();  
            ind.LastName = lname;  
            ind.HasOptedOutSolicit = !hasOptedSolicit;  
            ind.HasOptedOutTracking = !hasOptedTracking;
```

```

        insert(ind);

        // Other contact information can be updated here.
        Contact contact = new Contact();
        contact.Id = u.ContactId;
        contact.IndividualId = ind.Id;
        update(contact);

        // return login url.
        if (userId != null && password != null && password.length() > 1) {
            ApexPages.PageReference lgn = Site.login(username, password, startUrl);

            return lgn.getUrl();
        }
    }
    catch (Exception ex) {
        Database.rollback(sp);
        System.debug(ex.getMessage());
        return null;
    }
    return null;
}
Collapse
}

```

SEE ALSO:

[Salesforce Help: Allow Guest Users to Access Flows](#)

Create Custom Search and Profile Menu Components for Communities

Create custom components to replace the Customer Service template's standard Profile Header and Search & Post Publisher components in Community Builder.

forceCommunity:profileMenuItem

Add the `forceCommunity:profileMenuItem` interface to an Aura component to allow it to be used as a custom profile menu component for the Customer Service community template. After you create a custom profile menu component, admins can select it in Community Builder in **Settings > Theme** to replace the template's standard Profile Header component.

Here's the sample code for a simple profile menu component.

```

<aura:component implements="forceCommunity:profileMenuItem" access="global">
    <aura:attribute name="options" type="String[]" default="Option 1, Option 2"/>
    <ui:menu >
        <ui:menuTriggerLink aura:id="trigger" label="Profile Menu"/>
        <ui:menuList class="actionMenu" aura:id="actionMenu">
            <aura:iteration items="={!v.options}" var="itemLabel">
                <ui:actionMenuItem label=" {!itemLabel}" click=" {!c.handleClick}"/>
            </aura:iteration>
        </ui:menuList>
    </ui:menu>

```

```
</ui:menu>  
</aura:component>
```

forceCommunity:searchInterface

Add the `forceCommunity:searchInterface` interface to an Aura component to allow it to be used as a custom search component for the Customer Service community template. After you create a custom search component, admins can select it in Community Builder in **Settings > Theme** to replace the template's standard Search & Post Publisher component.

Here's the sample code for a simple search component.

```
<aura:component implements="forceCommunity:searchInterface" access="global">  
    <div class="search">  
        <div class="search-wrapper">  
            <form class="search-form">  
                <div class="search-input-wrapper">  
                    <input class="search-input" type="text" placeholder="My Search"/>  
                </div>  
                <input type="hidden" name="language" value="en" />  
            </form>  
        </div>  
    </div>  
</aura:component>
```

SEE ALSO:

[Create Custom Theme Layout Components for Communities](#)

[Salesforce Help: Custom Theme Layouts and Theme Layout Types](#)

Create Custom Content Layout Components for Communities

Community Builder includes several ready-to-use layouts that define the content regions of your page, such as a two-column layout with a 2:1 ratio. However, if you need a layout that's customized for your community, create a custom content layout component to use when building new pages in Community Builder. You can also update the content layout of the default pages that come with your community template.

When you create a custom content layout component in the Developer Console, it appears in Community Builder in the New Page and the Change Layout dialog boxes.

1. Add a New Interface to Your Content Layout Component

To appear in the New Page and the Change Layout dialog boxes in Community Builder, a content layout component must implement the `forceCommunity:layout` interface.

Here's the sample code for a simple two-column content layout.

```
<aura:component implements="forceCommunity:layout" description="Custom Content Layout"  
access="global">  
    <aura:attribute name="column1" type="Aura.Component[]" required="false"></aura:attribute>  
  
    <aura:attribute name="column2" type="Aura.Component[]" required="false"></aura:attribute>
```

```
<div class="container">
    <div class="contentPanel">
        <div class="left">
            {!v.column1}
        </div>
        <div class="right">
            {!v.column2}
        </div>
    </div>
</aura:component>
```

 **Note:** Mark your resources, such as a component, with `access="global"` to make the resource usable outside of your own org. For example, if you want a component to be usable in an installed package or by a Lightning App Builder user or a Community Builder user in another org.

2. Add a CSS Resource to Your Component Bundle

Next, add a CSS resource to style the content layout as needed.

Here's the sample CSS for our simple two-column content layout.

```
.THIS .contentPanel:before,
.THIS .contentPanel:after {
    content: " ";
    display: table;
}
.THIS .contentPanel:after {
    clear: both;
}
.THIS .left {
    float: left;
    width: 50%;
}
.THIS .right {
    float: right;
    width: 50%;
}
```

CSS resources must be named `componentName.css`.

3. Optional: Add an SVG Resource to Your Component Bundle

You can include an SVG resource in your component bundle to define a custom icon for the content layout component when it appears in the Community Builder.

The recommended image size for a content layout component in Community Builder is 170px by 170px. However, if the image has different dimensions, Community Builder scales the image to fit.

SVG resources must be named `componentName.svg`.

SEE ALSO:

[Component Bundles](#)

[Standard Design Tokens for Communities](#)

Use Aura Components with Flows

Customize the look-and-feel and functionality of your flows by adding Lightning components to them. Or wrap a flow in an Aura component to configure the flow at runtime, such as to control how a paused flow is resumed.

IN THIS SECTION:

[Considerations for Configuring Components for Flows](#)

Before you configure an Aura component for a flow, determine whether it should be available in flow screens or as flow actions and understand how to map data types between a flow and an Aura component. Then review some considerations for defining attributes and how components behave in flows at runtime.

[Customize Flow Screens Using Aura Components](#)

To customize the look and feel of your flow screen, build a custom Aura component. Configure the component and its design resource so that they're compatible with flow screens. Then in Flow Builder, add a screen component to the screen.

[Create Flow Local Actions Using Aura Components](#)

To execute client-side logic in your flow, build or modify custom Aura components to use as local actions in flows. For example, get data from third-party systems without going through the Salesforce server, or open a URL in another browser tab. Once you configure the Aura component's markup, client-side controller, and design resource, it's available in Flow Builder as a Core Action element.

[Embed a Flow in a Custom Aura Component](#)

Once you embed a flow in an Aura component, use JavaScript and Apex code to configure the flow at run time. For example, pass values into the flow or to control what happens when the flow finishes. `lightning:flow` supports only screen flows and autolaunched flows.

[Display Flow Stages with an Aura Component](#)

If you've added stages to your flow, display them to flow users with an Aura component, such as `lightning:progressindicator`.

Considerations for Configuring Components for Flows

Before you configure an Aura component for a flow, determine whether it should be available in flow screens or as flow actions and understand how to map data types between a flow and an Aura component. Then review some considerations for defining attributes and how components behave in flows at runtime.



Note:

- Lightning components in flows must comply with [Lightning Locker](#) restrictions.
- Flows that include Lightning components are supported only in [Lightning runtime](#).

IN THIS SECTION:

[Flow Screen Components vs. Flow Action Components](#)

You can make your Aura component available in flow screens or as a flow action. When choosing between the flow interfaces, consider what purpose the component serves in the flow.

[Which Aura Attribute Types Are Supported in Flows?](#)

Not all Aura data types are supported in flows. You can map only these types and their associated collection types between flows and Aura components.

[Design Attribute Considerations for Flow Screen Components and Local Actions](#)

To expose an attribute in Flow Builder, define a corresponding `design:attribute` in the component bundle's design resource. Keep these guidelines in mind when defining design attributes for flows.

[Runtime Considerations for Flows That Include Aura Components](#)

Depending on where you run your flow, Aura components may look or behave differently than expected. The flow runtime app that's used for some distribution methods doesn't include all the necessary resources from the Lightning Component framework. When a flow is run from Flow Builder or a direct flow URL (<https://yourDomain.my.salesforce.com/flow/MyFlowName>), `force` and `lightning` events aren't handled.

SEE ALSO:

[Component Library: lightning:availableForFlowScreens Interface](#)

[Component Library: lightning:availableForFlowActions Interface](#)

[What is Lightning Locker?](#)

Flow Screen Components vs. Flow Action Components

You can make your Aura component available in flow screens or as a flow action. When choosing between the flow interfaces, consider what purpose the component serves in the flow.

| For this use case... | Create a... |
|--|-----------------------|
| Provide UI for the user to interact with | Flow screen component |
| Update the screen in real time | Flow screen component |
| Prevent the flow from continuing until the component is done | Flow action component |
| Make direct data queries to on-premise or private cloud data | Flow action component |

SEE ALSO:

[Component Library: lightning:availableForFlowScreens Interface](#)

[Component Library: lightning:availableForFlowActions Interface](#)

Which Aura Attribute Types Are Supported in Flows?

Not all Aura data types are supported in flows. You can map only these types and their associated collection types between flows and Aura components.

| Flow Data Type | Aura Attribute Type | Valid Values |
|---|---|---|
| Boolean | Boolean | <ul style="list-style-type: none"> True values: <code>true</code>, <code>1</code>, or equivalent expression False values: <code>false</code>, <code>0</code>, or equivalent expression |
| Currency | Number | Numeric value or equivalent expression |
| Date | Date | <code>"YYYY-MM-DD"</code> or equivalent expression |
| Date/Time (API name is <code>DateTime</code>) | DateTime | <code>"YYYY-MM-DDThh:mm:ssZ"</code> or equivalent expression |
| Number | Number | Numeric value or equivalent expression |
| Multi-Select Picklist (API name is Multi-Select Picklist.) | String | String value or equivalent expression using this format: <code>"Blue; Green; Yellow"</code> |
| Picklist | String | String value or equivalent expression |
| Record, with a specified object (API name is <code>SObject</code> .) | The API name of the specified object, such as <code>Account</code> or <code>Case</code> | <p>Map of key-value pairs or equivalent expression.</p> <p>Flow record values map only to attributes whose type is the specific object. For example, an account record variable can be mapped only to an attribute whose type is <code>Account</code>. Flow data types aren't compatible with attributes whose type is <code>Object</code>.</p> |
| Text (API name is <code>Text</code> .) | String | String value or equivalent expression |

SEE ALSO:

[Component Library: lightning:flow Component](#)

[Component Library: lightning:availableForFlowScreens Interface](#)

[Component Library: lightning:availableForFlowActions Interface](#)

Design Attribute Considerations for Flow Screen Components and Local Actions

To expose an attribute in Flow Builder, define a corresponding `design:attribute` in the component bundle's design resource. Keep these guidelines in mind when defining design attributes for flows.

Supported Attributes on `design:attribute` Nodes

In a `design:attribute` node, Flow Builder supports only the `name`, `label`, `description`, and `default` attributes. The other attributes, like `min` and `max`, are ignored.

For example, for this design attribute definition, Flow Builder ignores required and placeholder.

```
<design:attribute name="greeting" label="Greeting" placeholder="Hello" required="true"/>
```

Calculating Minimum and Maximum Values for an Attribute

To validate min and max lengths for a component attribute, use a flow formula or the component's client-side controller.

Modifying or Deleting `design:attribute` Nodes

If a component's attribute is referenced in a flow, you can't change the attribute's type or remove it from the design resource. This limitation applies to all flow versions, not just active ones. Remove references to the attribute in all flow versions, and then edit or delete the attribute in the design resource.

SEE ALSO:

[Component Library: lightning:availableForFlowScreens Interface](#)

[Component Library: lightning:availableForFlowActions Interface](#)

Runtime Considerations for Flows That Include Aura Components

Depending on where you run your flow, Aura components may look or behave differently than expected. The flow runtime app that's used for some distribution methods doesn't include all the necessary resources from the Lightning Component framework. When a flow is run from Flow Builder or a direct flow URL (<https://yourDomain.my.salesforce.com/flow/MyFlowName>), `force` and `lightning` events aren't handled.

To verify the behavior of your Aura components, test your flow in a way that handles `force` and `lightning` events, such as `force: showToast`. You can also add the appropriate event handlers directly to your component.

| Distribution Method | Handles force and lightning Events |
|---|--|
| Direct flow URL | |
| Run and Debug buttons in Flow Builder | |
| Run links on the flow detail and list pages | |
| Web tab | |
| Custom button or link | |
| Lightning page | ✓ |
| Lightning community page | ✓ |
| Flow action | ✓ |
| Utility bar | ✓ |
| <code>flow:interview</code> Visualforce component | |
| <code>lightning:flow</code> Aura component | Depends on where you embed the component or whether your component includes the appropriate event handlers |

SEE ALSO:

[Component Library: lightning:availableForFlowScreens Interface](#)

[Component Library: lightning:availableForFlowActions Interface](#)

[Events Handled in the Salesforce Mobile App and Lightning Experience](#)

Customize Flow Screens Using Aura Components

To customize the look and feel of your flow screen, build a custom Aura component. Configure the component and its design resource so that they're compatible with flow screens. Then in Flow Builder, add a screen component to the screen.

IN THIS SECTION:

[Configure Components for Flow Screens](#)

Make your custom Aura components available to flow screens in Flow Builder by implementing the `lightning:availableForFlowScreens` interface.

[Control Flow Navigation from an Aura Component](#)

By default, users navigate a flow by clicking standard buttons at the bottom of each screen. The `lightning:availableForFlowScreens` interface provides two attributes to help you fully customize your screen's navigation. To figure out which navigation actions are available for the screen, loop through the `availableActions` attribute. To programmatically trigger one of those actions, call the `navigateFlow` action from your JavaScript controller.

[Customize the Flow Header with an Aura Component](#)

To replace the flow header with an Aura component, use the `screenHeaderText` parameter from the `lightning:availableForFlowScreens` interface.

[Dynamically Update a Flow Screen with an Aura Component](#)

To conditionally display a field on your screen, build an Aura component that uses `aura:if` to check when parts of the component should appear.

SEE ALSO:

[Component Library: lightning:availableForFlowScreens Interface](#)

[Create Flow Local Actions Using Aura Components](#)

Configure Components for Flow Screens

Make your custom Aura components available to flow screens in Flow Builder by implementing the `lightning:availableForFlowScreens` interface.

Here's the sample code for a simple "Hello World" component.

```
<aura:component implements="lightning:availableForFlowScreens" access="global">
    <aura:attribute name="greeting" type="String" access="global" />
    <aura:attribute name="subject" type="String" access="global" />

    <div style="box">
        <span class="greeting">{!v.greeting}</span>, {!v.subject}!
    </div>
</aura:component>
```



Note: Mark your resources with `access="global"` to make it usable outside of your own org, such as to make a component usable by a flow admin in another org.

To make an attribute's value customizable in Flow Builder, add it to the component's design resource. That way, flow admins can pass values between that attribute and the flow when they configure the Core Action element. That way, flow admins can pass values between that attribute and the flow when they configure the screen component.

With this sample design resource, flow admins can customize the values for the “Hello World” component’s attributes.

```
<design:component label="Hello World">
  <design:attribute name="greeting" label="Greeting" />
  <design:attribute name="subject" label="Subject" />
</design:component>
```

A design resource describes the design-time behavior of a Lightning component—information that visual tools need to allow adding the component to a page or app. Adding this resource is similar to adding it for the Lightning App Builder.

When admins reference this component in a flow, they can set each attribute using values from the flow. And they can store each attribute’s output value in a flow variable.

SEE ALSO:

[Control Flow Navigation from an Aura Component](#)

[*Component Library:* lightning:availableForFlowScreens Interface](#)

[What is Lightning Locker?](#)

Control Flow Navigation from an Aura Component

By default, users navigate a flow by clicking standard buttons at the bottom of each screen. The `lightning:availableForFlowScreens` interface provides two attributes to help you fully customize your screen’s navigation. To figure out which navigation actions are available for the screen, loop through the `availableActions` attribute. To programmatically trigger one of those actions, call the `navigateFlow` action from your JavaScript controller.

When you override the screen’s navigation with an Aura component, remember to hide the footer so that the screen has only one navigation model.

IN THIS SECTION:

[Flow Navigation Actions](#)

The `availableActions` attribute lists the valid navigation actions for that screen.

[Customize the Flow Footer with an Aura Component](#)

To replace the flow footer with an Aura component, use the parameters that the `lightning:availableForFlowScreens` interface provides. The `availableActions` array lists which actions are available for the screen, and the `navigateFlow` action lets you invoke one of the available actions.

[Build a Custom Navigation Model for Your Flow Screens](#)

Since Aura components have access to a flow screen’s navigation actions, you can fully customize how the user moves between screens. For example, hide the default navigation buttons and have the flow move to the next screen when the user selects a choice.

SEE ALSO:

[*Component Library:* lightning:availableForFlowScreens Interface](#)

Flow Navigation Actions

The `availableActions` attribute lists the valid navigation actions for that screen.

A screen’s available actions are determined by:

- Where in the flow the screen is. For example, Previous isn't supported on the first screen in a flow, Finish is supported for only the last screen in a flow, and you can never have both Next and Finish.
- Whether the flow creator opted to hide any of the actions in the screen's Control Navigation settings. For example, if Pause is de-selected, the Pause action isn't included in availableActions.

Here are the possible actions, their default button label, and what's required for that action to be valid.

| Action | Button Label | Description |
|--------|--------------|--|
| NEXT | Next | Navigates to the next screen |
| BACK | Previous | Navigates to the previous screen |
| PAUSE | Pause | Saves the interview in its current state to the database, so that the user can resume it later |
| RESUME | Resume | Resumes a paused interview |
| FINISH | Finish | Finishes the interview. This action is available only before the final screen in the flow. |

SEE ALSO:

[Component Library: lightning:availableForFlowScreens Interface](#)

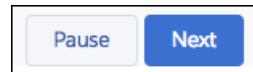
Customize the Flow Footer with an Aura Component

To replace the flow footer with an Aura component, use the parameters that the `lightning:availableForFlowScreens` interface provides. The `availableActions` array lists which actions are available for the screen, and the `navigateFlow` action lets you invoke one of the available actions.

By default, the flow footer displays the available actions as standard buttons. Next and Finish use the brand variant style, and Previous and Pause use the neutral variant. Also, Pause floats left, while the rest of the buttons float right.

 **Example:** This component (`c:flowFooter`) customizes the default flow footer in two ways.

- It swaps the Pause and Previous buttons, so that Previous floats to the left and Pause floats to the right with Next or Finish.
- It changes the label for the Finish button to Done.



`c:flowFooter` Component

Since the component implements `lightning:availableForFlowScreens`, it has access to the `availableActions` attribute, which contains the valid actions for the screen. The declared attributes, like `canPause` and `canBack`, determine which buttons to display. Those attributes are set by the JavaScript controller when the component initializes.

```
<aura:component access="global" implements="lightning:availableForFlowScreens">

    <!-- Determine which actions are available -->
    <aura:attribute name="canPause" type="Boolean" />
    <aura:attribute name="canBack" type="Boolean" />
    <aura:attribute name="canNext" type="Boolean" />
    <aura:attribute name="canFinish" type="Boolean" />
    <aura:handler name="init" value="{!this}" action="{!c.init}" />
```

```
<div aura:id="actionButtonBar" class="slds-clearfix slds-p-top_medium">
    <!-- If Previous is available, display to the left -->
    <div class="slds-float_left">
        <aura:if isTrue="{!v.canBack}">
            <lightning:button aura:id="BACK" label="Previous"
                variant="neutral" onclick="{!!c.onButtonPressed}" />
        </aura:if>
    </div>
    <div class="slds-float_right">
        <!-- If Pause, Next, or Finish are available, display to the right -->
        <aura:if isTrue="{!v.canPause}">
            <lightning:button aura:id="PAUSE" label="Pause"
                variant="neutral" onclick="{!!c.onButtonPressed}" />
        </aura:if>
        <aura:if isTrue="{!v.canNext}">
            <lightning:button aura:id="NEXT" label="Next"
                variant="brand" onclick="{!!c.onButtonPressed}" />
        </aura:if>
        <aura:if isTrue="{!v.canFinish}">
            <lightning:button aura:id="FINISH" label="Done"
                variant="brand" onclick="{!!c.onButtonPressed}" />
        </aura:if>
    </div>
</div>
</aura:component>
```

c:flowFooter Controller

The `init` function loops through the screen's available actions and determines which buttons the component should show. When the user clicks one of the buttons in the footer, the `onButtonPressed` function calls the `navigateFlow` action to perform that action.

```
{
    init : function(cmp, event, helper) {
        // Figure out which buttons to display
        var availableActions = cmp.get('v.availableActions');
        for (var i = 0; i < availableActions.length; i++) {
            if (availableActions[i] == "PAUSE") {
                cmp.set("v.canPause", true);
            } else if (availableActions[i] == "BACK") {
                cmp.set("v.canBack", true);
            } else if (availableActions[i] == "NEXT") {
                cmp.set("v.canNext", true);
            } else if (availableActions[i] == "FINISH") {
                cmp.set("v.canFinish", true);
            }
        }
    },
    onButtonPressed: function(cmp, event, helper) {
        // Figure out which action was called
        var actionClicked = event.getSource().getLocalId();
        // Fire that action
        var navigate = cmp.get('v.navigateFlow');
```

```

        navigate(actionClicked);
    }
}
)
```

Control Screen Navigation from a Child Component

If you're using a child component to handle the screen's navigation, pass the `navigateFlow` action and the `availableActions` attribute down from the parent component – the one that implements `lightning:availableForFlowScreens`. You can pass the available actions by setting the child component's attributes, but you can't pass the action. Instead, use a custom event to send the selected action up to the parent component.

Example: `c:navigateFlow` Event

Create an event with an action attribute, so that you can pass the selected action into the event.

```
<aura:event type="APPLICATION" >
    <aura:attribute name="action" type="String"/>
</aura:event>
```

`c:flowFooter` Component

In your component, before the handler:

- Define an attribute to pass the screen's available actions from the parent component
- Register an event to pass the `navigateFlow` action to the parent component

```
<aura:attribute name="availableActions" type="String[]" />
<aura:registerEvent name="navigateFlowEvent" type="c:navigateFlow"/>
```

`c:flowFooter` Controller

Since `navigateFlow` is only available in the parent component, the `onButtonPressed` function fails. Update the `onButtonPressed` function so that it fires `navigateFlowEvent` instead.

```
onButtonPressed: function(cmp, event, helper) {
    // Figure out which action was called
    var actionClicked = event.getSource().getLocalId();

    // Call that action
    var navigate = cmp.getEvent("navigateFlowEvent");
    navigate.setParam("action", actionFired);
    navigate.fire();
}
```

`c:flowParent` Component

In the parent component's markup, pass `availableActions` into the child component's `availableActions` attribute and the `handleNavigate` function into the child component's `navigateFlowEvent` event.

```
<c:flowFooter availableActions="{!v.availableActions}"
    navigateFlowEvent="{!c.handleNavigate}"/>
```

`c:flowParent` Controller

When `navigateFlowEvent` fires in the child component, the `handleNavigate` function calls the parent component's `navigateFlow` action, using the action selected in the child component.

```
handleNavigate: function(cmp, event) {
    var navigate = cmp.get("v.navigateFlow");
    navigate(event.getParam("action"));
}
```

SEE ALSO:

[Customize the Flow Header with an Aura Component](#)

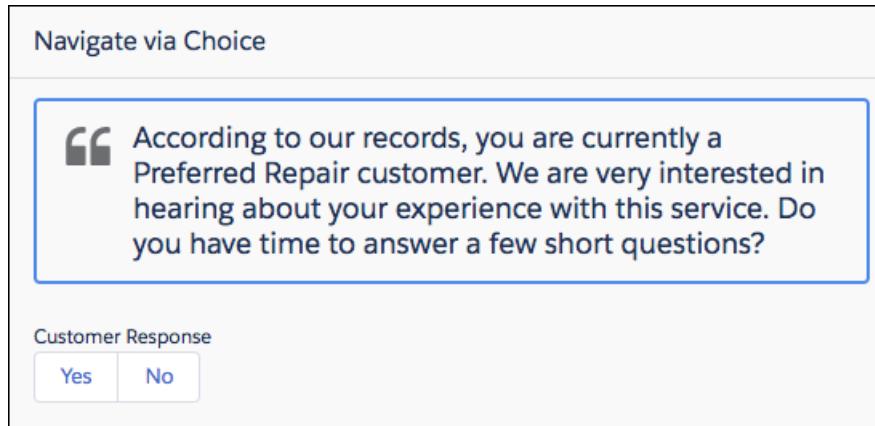
[Dynamically Update a Flow Screen with an Aura Component](#)

[Component Library: lightning:availableForFlowScreens Interface](#)

Build a Custom Navigation Model for Your Flow Screens

Since Aura components have access to a flow screen's navigation actions, you can fully customize how the user moves between screens. For example, hide the default navigation buttons and have the flow move to the next screen when the user selects a choice.

 **Example:** This component (`c:choiceNavigation`) displays a script and a choice in the form of buttons.



`c:choiceNavigation` Component

```
<aura:component implements="lightning:availableForFlowScreens" access="global" >
    <!-- Get the script text from the flow -->
    <aura:attribute name="scriptText" type="String" required="true" />
    <!-- Pass the value of the selected option back to the flow -->
    <aura:attribute name="value" type="String" />

    <!-- Display the script to guide the agent's call -->
    <div class="script-container">
        <div class="slds-card__header slds-grid slds-p-bottom_small slds-m-bottom_none">
            <div class="slds-media slds-media_center slds-has-flexi-truncate" >
                <div class="slds-media__figure slds-align-top">
                    <h2><lightning:icon iconName="utility:quotation_marks" title="Suggested script" /></h2>
```

```

        </div>
        <div class="slds-media__body">
            <ui:outputRichText class="script" value="{!!v.scriptText}"/>
        </div>
    </div>
</div>
<!-- Buttons for the agent to click, according to the customer's response --&gt;
&lt;div class="slds-p-top_large slds-p-bottom_large"&gt;
    &lt;p&gt;&lt;lightning:formattedText value="Customer Response"
        class="slds-text-body_small" /&gt;&lt;/p&gt;
    &lt;lightning:buttongroup&gt;
        &lt;lightning:button label="Yes" aura:id="Participate_Yes"
            variant="neutral" onclick="{!!c.handleChange}"/&gt;
        &lt;lightning:button label="No" aura:id="Participate_No"
            variant="neutral" onclick="{!!c.handleChange}"/&gt;
    &lt;/lightning:buttongroup&gt;
&lt;/div&gt;
&lt;/aura:component&gt;
</pre>

```

c:choiceNavigation Design

The design resource includes the `scriptText` attribute, so you can set the script from the flow.

```

<design:component>
    <design:attribute name="scriptText" label="Script Text"
        description="What the agent should say to the customer" />
</design:component>

```

c:choiceNavigation Style

```

.THIS.script-container {
    border: t(borderWidthThick) solid t(colorBorderBrand);
    border-radius: t(borderRadiusMedium);
}

.THIS .script {
    font-size: 1.125rem; /*t(fontSizeTextLarge)*/
    font-weight: t(fontWeightRegular);
    line-height: t(lineHeightHeading);
}

```

c:choiceNavigation Controller

When the user clicks either of the buttons, the JavaScript controller calls `navigateFlow("NEXT")`, which is the equivalent of the user clicking **Next**.

```

({
    handleChange : function(component, event, helper) {
        // When an option is selected, navigate to the next screen
        var response = event.getSource().getLocalId();
        component.set("v.value", response);
        var navigate = component.get("v.navigateFlow");
        navigate("NEXT");
    }
})

```

defaultTokens.tokens

The script in `c:choiceNavigation` uses tokens to stay in sync with the Salesforce Lightning Design System styles.

```
<aura:tokens extends="force:base" >
</aura:tokens>
```

SEE ALSO:

[Component Library: lightning:availableForFlowScreens Interface](#)

Customize the Flow Header with an Aura Component

To replace the flow header with an Aura component, use the `screenHelpText` parameter from the `lightning:availableForFlowScreens` interface.

By default, the flow header includes the title of the flow that's running and a button, where users can access screen-level help.

 **Example:** Instead of displaying the flow title and the help button, this component (`c:flowHeader`) displays the company logo and the help button. The help text appears in a tooltip when the user hovers, instead of in a modal when the user clicks.

**c:flowHeader Component**

Since the component implements `lightning:availableForFlowScreens`, it has access to the `screenHelpText` attribute, which contains the screen's help text if it has any.

```
<aura:component access="global" implements="lightning:availableForFlowScreens">

    <div class="slds-p-top_medium slds-clearfix">
        <div class="slds-float_left">
            <!-- Display company logo -->
            <h2></h2>
        </div>
        <div class="slds-float_right" style="position:relative;">
            <aura:if isTrue=" {!v.screenHelpText ne null}">
                <!-- If the screen has help text, display an info icon in the header.
                    On hover, display the screen's help text -->
                <lightning:helptext content=" {!v.screenHelpText}" />
            </aura:if>
        </div>
    </div>
```

```
</div>
</aura:component>
```

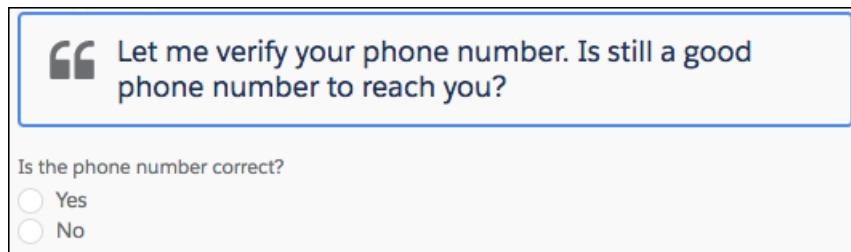
SEE ALSO:

[Customize the Flow Footer with an Aura Component](#)[Dynamically Update a Flow Screen with an Aura Component](#)[Component Library: lightning:availableForFlowScreens Interface](#)

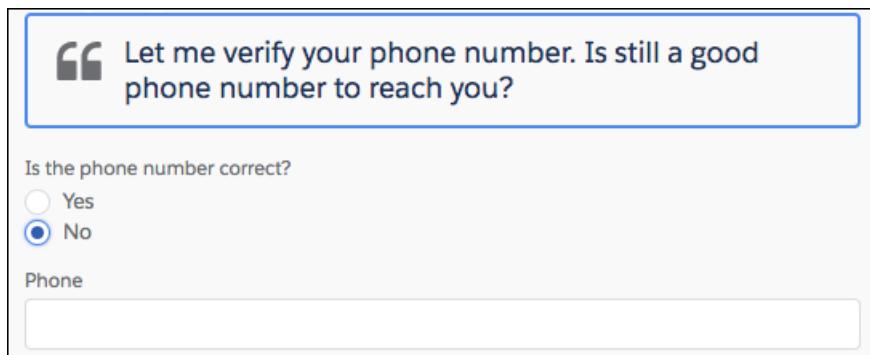
Dynamically Update a Flow Screen with an Aura Component

To conditionally display a field on your screen, build an Aura component that uses `aura:if` to check when parts of the component should appear.

 **Example:** This component (`c:flowDynamicScreen`) displays a custom script component and a group of radio buttons. The component gets the contact's existing phone number from the flow, and uses that value to fill in the script.



If the user selects the No radio button, the component displays an input, where the user can enter the new phone number.



c:flowDynamicScreen Component

```
<aura:component access="global" implements="lightning:availableForFlowScreens">
    <aura:attribute name="oldPhone" type="String" />
    <aura:attribute name="newPhone" type="String" />
    <aura:attribute name="radioOptions" type="List" default="[
        {'label': 'Yes', 'value': 'false'},
        {'label': 'No', 'value': 'true'} ]"/>
    <aura:attribute name="radioValue" type="Boolean" />
```

```

<!-- Displays script to guide the agent's call -->
<div class="script-container">
    <div class="slds-card__header slds-grid slds-p-bottom_small slds-m-bottom_none">

        <div class="slds-media slds-media_center slds-has-flexi-truncate" >
            <div class="slds-media__figure slds-align-top">
                <h2><lightning:icon iconName="utility:quotation_marks" title="Suggested script" /></h2>
            </div>
            <div class="slds-media__body">
                <!-- Inserts the user's current number, pulled from the flow, into the
                script -->
                <ui:outputRichText class="script" value="{'Let me verify your phone
                number.
                Is ' + v.oldPhone + ' still a good phone number to reach you?'}"/>
            </div>
        </div>
    </div>
</div>
<!-- Displays a radio button group to enter the customer's response -->
<div class="slds-p-top_medium slds-p-bottom_medium">
    <lightning:radioGroup aura:id="rbg_correct" name="rbg_correct"
        label="Is the phone number correct?"
        options="{'v.radioOptions'}" value="{'v.radioValue'}" />
    <!-- If the current number is wrong,
        displays a field to enter the correct number -->
    <aura:if isTrue="{'v.radioValue'}">
        <lightning:input type="tel" aura:id="phone_updated" label="Phone"
            onblur="{'c.handleNewPhone'}" class="slds-p-top_small"/>
    </aura:if>
</div>
</aura:component>

```

c:flowDynamicScreen Style

```

.THIS.script-container {
    border: t(borderWidthThick) solid t(colorBorderBrand);
    border-radius: t(borderRadiusMedium);
}

.THIS .script {
    font-size: 1.125rem; /*t(fontSizeTextLarge)*/
    font-weight: t(fontWeightRegular);
    line-height: t(lineHeightHeading);
}

```

c:flowDynamicScreen Controller

When the user tabs out, or otherwise removes focus from the Phone input, the controller sets the `newPhone` attribute to the input value, so that you can reference the new number in the flow.

```

({
    handleNewPhone: function(cmp, event, helper) {
        cmp.set("v.newPhone", cmp.find('phone_updated').get('v.value'));
    }
})

```

```

        }
    })
}

defaultTokens.tokens

```

The script in `c:flowDynamicScreen` uses tokens to stay in sync with the Salesforce Lightning Design System styles.

```
<aura:tokens extends="force:base" >
</aura:tokens>
```

SEE ALSO:

[Customize the Flow Header with an Aura Component](#)

[Customize the Flow Footer with an Aura Component](#)

[Component Library: lightning:availableForFlowScreens Interface](#)

Create Flow Local Actions Using Aura Components

To execute client-side logic in your flow, build or modify custom Aura components to use as local actions in flows. For example, get data from third-party systems without going through the Salesforce server, or open a URL in another browser tab. Once you configure the Aura component's markup, client-side controller, and design resource, it's available in Flow Builder as a Core Action element.

Note:

- Lightning components in flows must comply with [Lightning Locker](#) restrictions.
- Flows that include Lightning components are supported only in [Lightning runtime](#).
- Lightning components require a browser context to run, so flow action components are supported only in screen flows.



Example: Here's a sample "c:helloWorld" component and its client-side controller, which triggers a JavaScript alert that says Hello, World. In Flow Builder, local actions are available from the Core Action element.

```
<aura:component implements="lightning:availableForFlowActions" access="global">
    <aura:attribute name="greeting" type="String" default="Hello" access="global" />
    <aura:attribute name="subject" type="String" default="World" access="global" />
</aura:component>

({
    // When a flow executes this component, it calls the invoke method
    invoke : function(component, event, helper) {
        alert(component.get("v.greeting") + ", " + component.get("v.subject"));
    }
})
```

IN THIS SECTION:

[Configure the Component Markup and Design Resource for a Flow Action](#)

Make your custom Aura components available as flow local actions by implementing the `lightning:availableForFlowActions` interface.

Configure the Client-Side Controller for a Flow Local Action

When a component is executed as a flow local action, the flow calls the `invoke` method in the client-side controller. To run the code asynchronously in your client-side controller, such as when you're making an XML HTTP request (XHR), return a Promise. When the method finishes or the Promise is fulfilled, control is returned back to the flow.

Cancel an Asynchronous Request in a Flow Local Action

If an asynchronous request times out, the flow executes the local action's fault connector and sets `$Flow.FaultMessage` to the error message. However, the original request isn't automatically canceled. To abort an asynchronous request, use the `cancelToken` parameter available in the `invoke` method.

SEE ALSO:

[Component Library: lightning:availableForFlowActions Interface](#)

[What is Lightning Locker?](#)

[Customize Flow Screens Using Aura Components](#)

Configure the Component Markup and Design Resource for a Flow Action

Make your custom Aura components available as flow local actions by implementing the `lightning:availableForFlowActions` interface.

 **Tip:** We recommend that you omit markup from local actions. Local actions tend to execute quickly, and any markup you add to them will likely disappear before the user can make sense of it. If you want to display something to users, check out [Customize Flow Screens Using Aura Components](#) instead.

Here's sample code for a simple "Hello World" component that sets a couple of attributes.

```
<aura:component implements="lightning:availableForFlowActions" access="global">
    <aura:attribute name="greeting" type="String" access="global" />
    <aura:attribute name="subject" type="String" access="global" />
</aura:component>
```

 **Note:** Mark your resources with `access="global"` to make it usable outside of your own org, such as to make a component usable by a flow admin in another org.

To make an attribute's value customizable in Flow Builder, add it to the component's design resource. That way, flow admins can pass values between that attribute and the flow when they configure the Core Action element. That way, flow admins can pass values between that attribute and the flow when they configure the corresponding Core Action element.

With this sample design resource, flow admins can customize the values for the "Hello World" component's attributes.

```
<design:component>
    <design:attribute name="greeting" label="Greeting" />
    <design:attribute name="subject" label="Subject" />
</design:component>
```

A design resource describes the design-time behavior of a Lightning component—information that visual tools need to allow adding the component to a page or app. Adding this resource is similar to adding it for the Lightning App Builder.

When admins reference this component in a flow, they can pass data between the flow and the Aura component. Use the Set Input Values tab to set an attribute using values from the flow. Use the Store Output Values tab to store an attribute's value in a flow variable.

SEE ALSO:

[Component Library: lightning:availableForFlowActions Interface](#)

[Configure the Client-Side Controller for a Flow Local Action](#)

Configure the Client-Side Controller for a Flow Local Action

When a component is executed as a flow local action, the flow calls the `invoke` method in the client-side controller. To run the code asynchronously in your client-side controller, such as when you're making an XML HTTP request (XHR), return a Promise. When the method finishes or the Promise is fulfilled, control is returned back to the flow.

Asynchronous Code

When a Promise is resolved, the next element in the flow is executed. When a Promise is rejected or hits the timeout, the flow takes the local action's fault connector and sets `$Flow.FaultMessage` to the error message.

By default, the error message is "An error occurred when the elementName element tried to execute the c:myComponent component." To customize the error message in `$Flow.FaultMessage`, return it as a new Error object in the `reject()` call.

```
({
    invoke : function(component, event, helper) {
        return new Promise(function(resolve, reject) {
            // Do something asynchronously, like get data from
            // an on-premise database

            // Complete the call and return to the flow
            if /* request was successful */ {
                // Set output values for the appropriate attributes
                resolve();
            } else {
                reject(new Error("My error message"));
            }
        });
    }
})
```



Note: If you're making callouts to an external server, whitelist the external server in your org and enable or configure CORS in the external server.

Synchronous Code

When the method finishes, the next element in the flow is executed.

```
({
    invoke : function(component, event, helper) {
        // Do something synchronously, like open another browser tab
        // with a specified URL

        // Set output values for the appropriate attributes
    }
})
```

```
    }
})
```

SEE ALSO:

- [Component Library: lightning:availableForFlowActions Interface](#)
- [Cancel an Asynchronous Request in a Flow Local Action](#)
- [Using External JavaScript Libraries](#)
- [Create CSP Trusted Sites to Access Third-Party APIs](#)

Cancel an Asynchronous Request in a Flow Local Action

If an asynchronous request times out, the flow executes the local action's fault connector and sets `$Flow.FaultMessage` to the error message. However, the original request isn't automatically canceled. To abort an asynchronous request, use the `cancelToken` parameter available in the `invoke` method.

 **Note:** By default, requests time out after 120 seconds. To override the default, assign a different Integer to the component's `timeout` attribute.

 **Example:** In this client-side controller, the `invoke` method returns a Promise. When the method has done all it needs to do, it completes the call and control returns to the flow.

- If the request is successful, the method uses `resolve()` to execute the next element in the flow after this action.
- If the request isn't successful, it uses `reject()` to execute the local action's fault connector and sets `$Flow.FaultMessage` to "My error message".
- If the request takes too long, it uses `cancelToken.promise.then` to abort the request.

```
(({
    invoke : function(component, event, helper) {
        var cancelToken = event.getParam("arguments").cancelToken;

        return new Promise(function(resolve, reject) {
            var xhttp = new XMLHttpRequest();

            // Do something, like get data from
            // a database behind your firewall
            xhttp.onreadystatechange = $A.getCallback(function() {
                if /* request was successful */ {
                    // Complete the call and return to the flow
                    resolve();
                } else {
                    reject(new Error("My error message"));
                }
            });
            // If the Promise times out, abort the request and
            // pass set $Flow.FaultMessage to "Request timed out"
            cancelToken.promise.then(function(error) {
                xhttp.abort();
                reject(new Error("Request timed out."));
            });
        });
    }
}))
```

```
        }) ;  
    }  
})
```

SEE ALSO:

[Component Library: lightning:availableForFlowActions Interface](#)

[Configure the Client-Side Controller for a Flow Local Action](#)

Embed a Flow in a Custom Aura Component

Once you embed a flow in an Aura component, use JavaScript and Apex code to configure the flow at run time. For example, pass values into the flow or to control what happens when the flow finishes. `lightning:flow` supports only screen flows and autolaunched flows.

A *flow* is an application, built with Flow Builder, that collects, updates, edits, and creates Salesforce information.

To embed a flow in your Aura component, add the `<lightning:flow>` component to it.

```
<aura:component>  
    <aura:handler name="init" value="{!this}" action=" {!c.init}" />  
    <lightning:flow aura:id="flowData" />  
</aura:component>  
  
({  
    init : function (component) {  
        // Find the component whose aura:id is "flowData"  
        var flow = component.find("flowData");  
        // In that component, start your flow. Reference the flow's API Name.  
        flow.startFlow("myFlow");  
    },  
})
```



Note: When a page loads that includes a flow component, such as Lightning App Builder or an active Lightning page, the flow runs. Make sure that the flow doesn't perform any actions – such as create or delete records – before the first screen.

IN THIS SECTION:

[Reference Flow Output Variable Values in a Wrapper Aura Component](#)

When you embed a flow in an Aura component, you can display or reference the flow's variable values. Use the `onstatuschange` action to get values from the flow's output variables. Output variables are returned as an array.

[Set Flow Input Variable Values from a Wrapper Aura Component](#)

When you embed a flow in a custom Aura component, give the flow more context by initializing its variables. In the component's controller, create a list of maps, then pass that list to the `startFlow` method.

[Control a Flow's Finish Behavior by Wrapping the Flow in a Custom Aura Component](#)

By default, when a flow user clicks **Finish**, a new interview starts and the user sees the first screen of the flow again. By embedding a flow in a custom Aura component, you can shape what happens when the flow finishes by using the `onstatuschange` action. To redirect to another page, use one of the `force:navigateTo*` events such as `force:navigateToObjectHome` or `force:navigateToUrl`.

[Resume a Flow Interview from an Aura Component](#)

By default, users can resume interviews that they paused from the Paused Interviews component on their home page. To customize how and where users can resume their interviews, embed the `lightning:flow` component in a custom Aura component. In your client-side controller, pass the interview ID into the `resumeFlow` method.

SEE ALSO:

[Component Library: lightning:flow Component](#)

Reference Flow Output Variable Values in a Wrapper Aura Component

When you embed a flow in an Aura component, you can display or reference the flow's variable values. Use the `onstatuschange` action to get values from the flow's output variables. Output variables are returned as an array.

 **Note:** The variable must allow output access. If you reference a variable that doesn't allow output access, attempts to get the variable are ignored.

 **Example:** This example uses the JavaScript controller to pass the flow's `accountName` and `numberOfEmployees` variables into attributes on the component. Then, the component displays those values in output components.

```
<aura:component>
    <aura:attribute name="accountName" type="String" />
    <aura:attribute name="numberOfEmployees" type="Decimal" />

    <p><lightning:formattedText value=" {!v.accountName}" /></p>
    <p><lightning:formattedNumber style="decimal" value=" {!v.numberOfEmployees}" /></p>

    <aura:handler name="init" value=" {!this}" action=" {!c.init}" />
    <lightning:flow aura:id="flowData" onstatuschange=" {!c.handleStatusChange}" />
</aura:component>
```

```
({
    init : function (component) {
        // Find the component whose aura:id is "flowData"
        var flow = component.find("flowData");
        // In that component, start your flow. Reference the flow's API Name.
        flow.startFlow("myFlow");
    },

    handleStatusChange : function (component, event) {
        if(event.getParam("status") === "FINISHED") {
            // Get the output variables and iterate over them
            var outputVariables = event.getParam("outputVariables");
            var outputVar;
            for(var i = 0; i < outputVariables.length; i++) {
                outputVar = outputVariables[i];
                // Pass the values to the component's attributes
                if(outputVar.name === "accountName") {
                    component.set("v.accountName", outputVar.value);
                } else {
                    component.set("v.numberOfEmployees", outputVar.value);
                }
            }
        }
    }
})
```

```

        },
    },
})
}

```

SEE ALSO:

[Component Library: lightning:flow Component](#)

Set Flow Input Variable Values from a Wrapper Aura Component

When you embed a flow in a custom Aura component, give the flow more context by initializing its variables. In the component's controller, create a list of maps, then pass that list to the startFlow method.

 **Note:** You can set variables only at the beginning of an interview, and the variables you set must allow input access. If you reference a variable that doesn't allow input access, attempts to set the variable are ignored.

For each variable you set, provide the variable's `name`, `type`, and `value`. For type, use the API name for the flow data type. For example, for a record variable use `SObject`, and for a text variable use `String`.

```

{
    name : "varName",
    type : "flowDataType",
    value : valueToSet
},
{
    name : "varName",
    type : "flowDataType",
    value : [ value1, value2]
}, ...

```

 **Example:** This JavaScript controller sets values for a number variable, a date collection variable, and a couple of record variables. The Record data type in Flow Builder corresponds to `SObject` here.

```

({
    init : function (component) {
        // Find the component whose aura:id is "flowData"
        var flow = component.find("flowData");
        var inputVariables = [
            { name : "numVar", type : "Number", value: 30 },
            { name : "dateColl", type : "String", value: [ "2016-10-27", "2017-08-01" ] }
        ],
        // Sets values for fields in the account record (sObject) variable. Id uses
        the
        // value of the component's accountId attribute. Rating uses a string.
        { name : "account", type : "SObject", value: {
            "Id" : component.get("v.accountId"),
            "Rating" : "Warm"
        }
        },
        // Set the contact record (sObject) variable to the value of the component's
        contact
        // attribute. We're assuming the attribute contains the entire sObject for
        // a contact record.
    }
})
}

```

```

        { name : "contact", type : "SObject", value: component.get("v.contact") }
    },
];
flow.startFlow("myFlow", inputVariables);
}
})

```



Example: Here's an example of a component that gets an account via an Apex controller. The Apex controller passes the data to the flow's record variable through the JavaScript controller.

```

<aura:component controller="AccountController" >
    <aura:attribute name="account" type="Account" />
    <aura:handler name="init" value="{!this}" action=" {!c.init}"/>
    <lightning:flow aura:id="flowData"/>
</aura:component>

public with sharing class AccountController {
    @AuraEnabled
    public static Account getAccount() {
        return [SELECT Id, Name, LastModifiedDate FROM Account LIMIT 1];
    }
}

({
    init : function (component) {
        // Create action to find an account
        var action = component.get("c.getAccount");

        // Add callback behavior for when response is received
        action.setCallback(this, function(response) {
            if (state === "SUCCESS") {
                // Pass the account data into the component's account attribute
                component.set("v.account", response.getReturnValue());
                // Find the component whose aura:id is "flowData"
                var flow = component.find("flowData");
                // Set the account record (sObject) variable to the value of the component's

                // account attribute.
                var inputVariables = [
                    {
                        name : "account",
                        type : "SObject",
                        value: component.get("v.account")
                    }
                ];

                // In the component whose aura:id is "flowData, start your flow
                // and initialize the account record (sObject) variable. Reference the
                flow.startFlow("myFlow", inputVariables);
            }
            else {
                console.log("Failed to get account data.");
            }
        });
    }
})

```

```

        }
    });

    // Send action to be executed
    $A.enqueueAction(action);
}
})

```

SEE ALSO:

- [Component Library: lightning:flow Component](#)
- [Which Aura Attribute Types Are Supported in Flows?](#)

Control a Flow's Finish Behavior by Wrapping the Flow in a Custom Aura Component

By default, when a flow user clicks **Finish**, a new interview starts and the user sees the first screen of the flow again. By embedding a flow in a custom Aura component, you can shape what happens when the flow finishes by using the `onstatuschange` action. To redirect to another page, use one of the `force:navigateTo*` events such as `force:navigateToObjectHome` or `force:navigateToUrl`.

 **Tip:** To control a flow's finish behavior at design time, make your custom Aura component available as a flow action by using the `lightning:availableForFlowActions` interface. To control what happens when an autolaunched flow finishes, check for the `FINISHED_SCREEN` status.

```
<aura:component access="global">
    <aura:handler name="init" value="{!this}" action=" {!c.init}" />
    <lightning:flow aura:id="flowData" onstatuschange=" {!c.handleStatusChange}" />
</aura:component>
```

```
// init function here
handleStatusChange : function (component, event) {
    if(event.getParam("status") === "FINISHED") {
        // Redirect to another page in Salesforce, or
        // Redirect to a page outside of Salesforce, or
        // Show a toast, or...
    }
}
```

 **Example:** This function redirects the user to a case created in the flow by using the `force:navigateToSObject` event.

```
handleStatusChange : function (component, event) {
    if(event.getParam("status") === "FINISHED") {
        var outputVariables = event.getParam("outputVariables");
        var outputVar;
        for(var i = 0; i < outputVariables.length; i++) {
            outputVar = outputVariables[i];
            if(outputVar.name === "redirect") {
                var urlEvent = $A.get("e.force:navigateToSObject");
                urlEvent.setParams({
                    "recordId": outputVar.value,
                    "isredirect": "true"
                });
                urlEvent.fire();
            }
        }
    }
}
```

```
        }
    }
}
```

SEE ALSO:

- [Component Library: lightning:flow Component](#)
- [Create Flow Local Actions Using Aura Components](#)

Resume a Flow Interview from an Aura Component

By default, users can resume interviews that they paused from the Paused Interviews component on their home page. To customize how and where users can resume their interviews, embed the `lightning:flow` component in a custom Aura component. In your client-side controller, pass the interview ID into the `resumeFlow` method.

```
{
  init : function (component) {
    // Find the component whose aura:id is "flowData"
    var flow = component.find("flowData");

    // In that component, resume a paused interview. Provide the method with
    // the ID of the interview that you want to resume.
    flow.resumeFlow("pausedInterviewId");
  },
})
```

 **Example:** This example shows how you can resume an interview—or start a new one. When users click **Survey Customer** from a contact record, the Aura component does one of two things.

- If the user has any paused interviews for the Survey Customers flow, it resumes the first one.
- If the user doesn't have any paused interviews for the Survey Customers flow, it starts a new one.

```
<aura:component controller="InterviewsController">
  <aura:handler name="init" value="{!this}" action=" {!c.init}" />
  <lightning:flow aura:id="flowData" />
</aura:component>
```

This Apex controller gets a list of paused interviews by performing a SOQL query. If nothing is returned from the query, `getPausedId()` returns a null value, and the component starts a new interview. If at least one interview is returned from the query, the component resumes the first interview in that list.

```
public class InterviewsController {
  @AuraEnabled
  public static String getPausedId() {
    // Get the ID of the running user
    String currentUser = UserInfo.getUserId();
    // Find all of that user's paused interviews for the Survey customers flow
    List<FlowInterview> interviews =
      [ SELECT Id FROM FlowInterview
        WHERE CreatedById = :currentUser AND InterviewLabel LIKE '%Survey
customers%' ];
```

```

        if (interviews == null || interviews.isEmpty()) {
            return null; // early out
        }
        // Return the ID for the first interview in the list
        return interviews.get(0).Id;
    }
}

```

If the Apex controller returned an interview ID, the client-side controller resumes that interview. If the Apex controller returned a null interview ID, the component starts a new interview.

```

({
    init : function (component) {
        //Create request for interview ID
        var action = component.get("c.getPausedId");
        action.setCallback(this, function(response) {
            var interviewId = response.getReturnValue();
            // Find the component whose aura:id is "flowData"
            var flow = component.find("flowData");
            // If an interview ID was returned, resume it in the component
            // whose aura:id is "flowData".
            if ( interviewId !== null ) {
                flow.resumeFlow(interviewID);
            }
            // Otherwise, start a new interview in that component. Reference
            // the flow's API Name.
            else {
                flow.startFlow("Survey_customers");
            }
        });
        //Send request to be enqueued
        $A.enqueueAction(action);
    },
})

```

SEE ALSO:

[Component Library: lightning:flow Component](#)

Display Flow Stages with an Aura Component

If you've added stages to your flow, display them to flow users with an Aura component, such as `lightning:progressindicator`.

To add a progress indicator component to your flow, you have two options:

- Wrap the progress indicator with a `lightning:flow` component in a parent component.

```

<aura:component>
    <lightning:progressindicator/>
    <lightning:flow/>
</aura:component>

```

- Add the progress indicator to your flow screen directly, by using a screen component.

IN THIS SECTION:

[Display Flow Stages by Wrapping a Progress Indicator](#)

If you're tracking stages in your flow, display them at runtime by creating a custom component that wraps a progress indicator with the `lightning:flow` component. Use the progress indicator to display the flow's active stages and current stage, and use the `lightning:flow` component to display the flow's screens. To pass the flow's active stages and current stage to the progress indicator, use the `lightning:flow` component's `onstatuschange` action.

[Display Flow Stages By Adding a Progress Indicator to a Flow Screen](#)

If you're tracking stages in your flow, display them at runtime by adding a custom component to the flow's screens. Create a progress indicator component that displays the flow's active stages and current stage, and make sure that it's available as for flow screens. When you add the component to each flow screen, pass the `$Flow.ActiveStages` and `$Flow.CurrentStage` global variables into the component's attributes.

SEE ALSO:

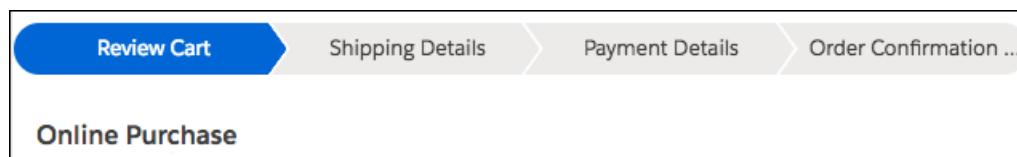
[Salesforce Help: Show Users Progress Through a Flow with Stages](#)

[Display Flow Stages By Adding a Progress Indicator to a Flow Screen](#)

Display Flow Stages by Wrapping a Progress Indicator

If you're tracking stages in your flow, display them at runtime by creating a custom component that wraps a progress indicator with the `lightning:flow` component. Use the progress indicator to display the flow's active stages and current stage, and use the `lightning:flow` component to display the flow's screens. To pass the flow's active stages and current stage to the progress indicator, use the `lightning:flow` component's `onstatuschange` action.

 **Example:** This `c:flowStages_global` component uses `lightning:progressIndicator` to display the flow's stages and `lightning:flow` to display the flow.



`c:flowStages_global` Component

```
<aura:component implements="flexipage:availableForAllPageTypes" access="global" >
    <aura:attribute name="currentStage" type="Object"/>
    <aura:attribute name="activeStages" type="Object[]"/>
    <!-- Get flow name from the Lightning App Builder -->
    <aura:attribute name="flowName" type="String"/>

    <aura:handler name="init" value="{!this}" action=" {!c.init} "/>
    <article class="slds-card">
        <lightning:progressIndicator aura:id="progressIndicator"
            currentStep=" {!v.currentStage.name}" type="path"/>
        <lightning:flow aura:id="flow" onstatuschange=" {!c.statusChange} "/>
    </article>
</aura:component>
```

`c:flowStages_global` Design

The design resource includes the `flowName` attribute, so you can specify which flow to start from Lightning App Builder.

```
<design:component>
  <design:attribute name="flowName" label="Flow Name"/>
</design:component>

c:flowStages_global Style

.THIS .slds-path__nav { margin-right: 0; }
.THIS .slds-path__item:only-child { border-radius: 15rem; }
```

c:flowStages_global Controller

The controller uses the `flowName` attribute to determine which flow to start.

Each time a new screen loads, the `onstatuschange` action fires, which gives the controller access to a handful of parameters about the flow. The `currentStage` and `activeStages` parameters return the labels and names of the relevant stages.

When `onstatuschange` fires in this component, it calls the controller's `statusChange` method. That method passes the flow's `currentStage` and `activeStages` parameters into the component's attributes. For each item in the `activeStages` attribute, the method adds a `lightning:progressStep` component to the component markup.

```
{
  init : function(component, event, helper) {
    var flow = component.find("flow");
    flow.startFlow(component.get("v.flowName"));
  },

  // When each screen loads ...
  statusChange : function(component, event, helper) {
    // Pass $Flow.ActiveStages into the activeStages attribute
    // and $Flow.CurrentStage into the currentStage attribute
    component.set("v.currentStage", event.getParam("currentStage"));
    component.set("v.activeStages", event.getParam("activeStages"));

    var progressIndicator = component.find("progressIndicator");
    var body = [];

    for(let stage of component.get("v.activeStages")) {
      // For each stage in activeStages...
      $A.createComponent(
        "lightning:progressStep",
        {
          // Create a progress step where label is the
          // stage label and value is the stage name
          "aura:id": "step_" + stage.name,
          "label": stage.label,
          "value": stage.name
        },
        function(newProgressStep, status, errorMessage) {
          //Add the new step to the progress array
          if (status === "SUCCESS") {
            body.push(newProgressStep);
          }
          else if (status === "INCOMPLETE") {
            // Show offline error
            console.log("No response from server or client is offline.")
          }
        }
      );
    }
  }
}
```

```

        }
        else if (status === "ERROR") {
            // Show error message
            console.log("Error: " + errorMessage);
        }
    );
}
progressIndicator.set("v.body", body);
})
})

```

SEE ALSO:

[Salesforce Help: Show Users Progress Through a Flow with Stages](#)[Display Flow Stages with an Aura Component](#)[Component Library: lightning:flow Component](#)

Display Flow Stages By Adding a Progress Indicator to a Flow Screen

If you're tracking stages in your flow, display them at runtime by adding a custom component to the flow's screens. Create a progress indicator component that displays the flow's active stages and current stage, and make sure that it's available as for flow screens. When you add the component to each flow screen, pass the `$Flow.ActiveStages` and `$Flow.CurrentStage` global variables into the component's attributes.

Pass the `$Flow.ActiveStages` and `$Flow.CurrentStage` global variables to the component's attributes. Then use those attributes to display the flow's active stages and select the current one.



Example: The `c:flowStages_field` component uses `lightning:progressIndicator` to display the flow's stages.



`c:flowStages_field` Component

```

<aura:component implements="lightning:availableForFlowScreens">
    <!-- Attributes that store $Flow.ActiveStages and $Flow.CurrentStage -->
    <aura:attribute name="stages" type="String[]" />
    <aura:attribute name="currentStage" type="String" />

    <aura:handler name="init" value="{!this}" action=" {!c.init} "/>
    <lightning:progressIndicator aura:id="progressIndicator"
        currentStep=" {!v.currentStage}"
        type="path" />
</aura:component>

```

`c:flowStages_field` Design

The design resource includes the `stages` and `currentStage` attributes so that they're available in Flow Builder. In the flow screen, pass `$Flow.ActiveStages` into the `stages` attribute, and pass `$Flow.CurrentStage` into the `currentStage` attribute.

```
<design:component>
    <design:attribute name="stages" label="Stages" description="What stages are active"/>

    <design:attribute name="currentStage" label="Current Stage" description="What is
the current stage?"/>
</design:component>
```

c:flowStages_fieldStyle

```
.THIS .slds-path__nav { margin-right: 0; }
.THIS .slds-path__item:only-child { border-radius: 15rem; }
```

c:flowStages_fieldController

When you add this component to a flow screen, you pass `$Flow.ActiveStages` into the `stages` attribute and `$Flow.CurrentStage` into the `currentStage` attribute. As a result, the component's attributes contain the relevant stages' labels but not the associated names. Each step in the progress indicator requires a label and a value, so this example sets both `label` and `value` to the stage label.

 **Tip:** Make sure that none of your flow's stages have the same label.

For each item in the `stages` attribute, the `init` method adds a `lightning:progressStep` component to the `c:flowStages_field` component markup.

```
({
    init : function(component, event, helper) {
        var progressIndicator = component.find('progressIndicator');
        for (let step of component.get('v.stages')) {
            $A.createComponent(
                "lightning:progressStep",
                {
                    "aura:id": "step_" + step,
                    "label": step,
                    "value": step
                },
                function(newProgressStep, status, errorMessage) {
                    // Add the new step to the progress array
                    if (status === "SUCCESS") {
                        var body = progressIndicator.get("v.body");
                        body.push(newProgressStep);
                        progressIndicator.set("v.body", body);
                    }
                    else if (status === "INCOMPLETE") {
                        // Show offline error
                        console.log("No response from server, or client is offline.");
                    }
                    else if (status === "ERROR") {
                        // Show error message
                        console.log("Error: " + errorMessage);
                    }
                }
            );
        };
    }
);
```

```
    }
}
})
```

SEE ALSO:

- [Salesforce Help: Show Users Progress Through a Flow with Stages](#)
- [Display Flow Stages with an Aura Component](#)
- [Display Flow Stages with an Aura Component](#)
- [Component Library: lightning:availableForFlowScreens Interface](#)

Add Components to Apps

When you’re ready to add components to your app, you should first look at the out-of-the-box components that come with the framework. You can also leverage these components by extending them or using composition to add them to custom components that you’re building.



Note: For all the out-of-the-box components, see the `Components` folder at <https://<myDomain>.lightning.force.com/auradocs/reference.app>, where `<myDomain>` is the name of your custom Salesforce domain. The `ui` namespace includes many components that are common on Web pages.

Components are encapsulated and their internals stay private, while their public shape is visible to consumers of the component. This strong separation gives component authors freedom to change the internal implementation details and insulates component consumers from those changes.

The public shape of a component is defined by the attributes that can be set and the events that interact with the component. The shape is essentially the API for developers to interact with the component. To design a new component, think about the attributes that you want to expose and the events that the component should initiate or respond to.

Once you have defined the shape of any new components, developers can work on the components in parallel. This is a useful approach if you have a team working on an app.

To add a new custom component to your app, see [Using the Developer Console](#) on page 6.

SEE ALSO:

- [Component Composition](#)
- [Using Object-Oriented Development](#)
- [Component Attributes](#)
- [Communicating with Events](#)

Integrate Your Custom Apps into the Chatter Publisher

Use the Chatter Rich Publisher Apps API to integrate your custom apps into the Chatter publisher. The Rich Publisher Apps API enables developers to attach any custom payload to a feed item. Rich Publisher Apps uses Lightning components for composition and rendering. We provide two Lightning interfaces and a Lightning event to assist with integration. You can package your apps and upload them to AppExchange. A community admin page provides a selector for choosing which five of your apps to add to the Chatter publisher for that community.

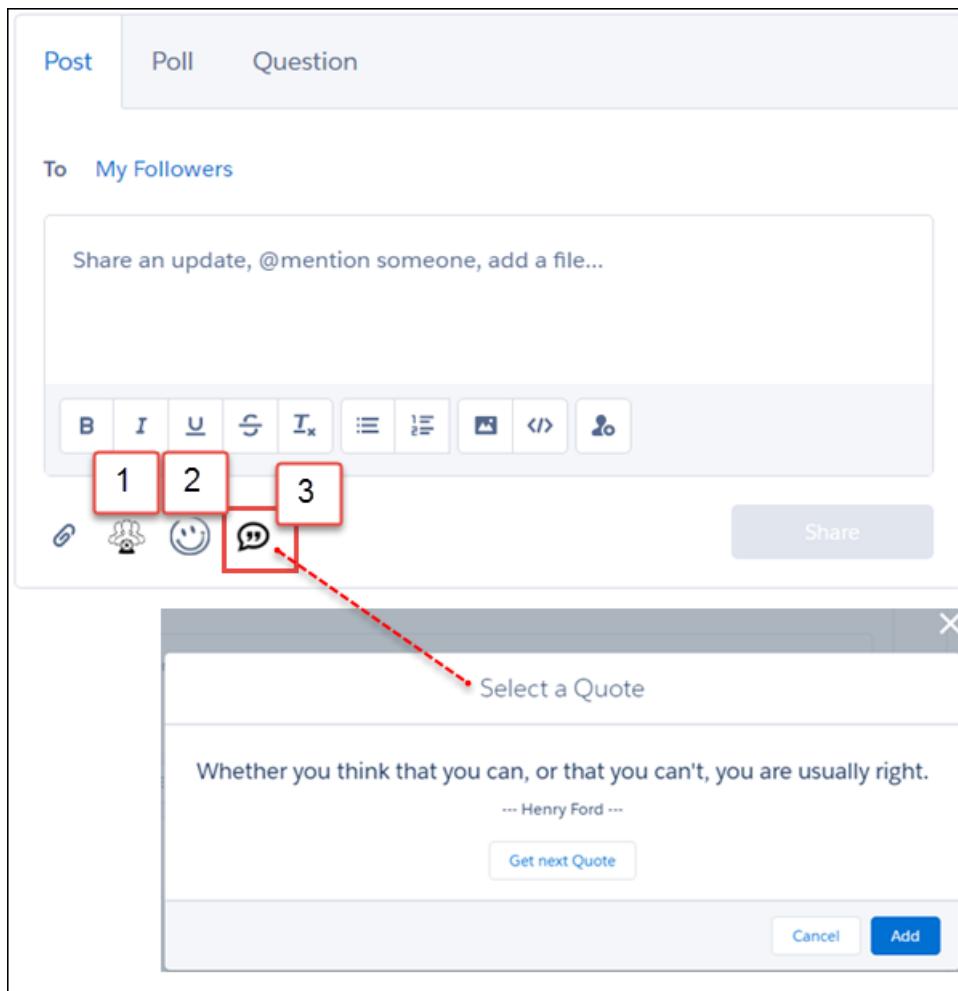
 **Note:** Rich Publisher Apps are available to Lightning communities in topics, group, and profile feeds and in direct messages.

Use the `lightning:availableForChatterExtensionComposer` and `lightning:availableForChatterExtensionRenderer` interfaces with the `lightning:sendChatterExtensionPayload` event to integrate your custom apps into the Chatter publisher and carry your apps' payload into a Chatter feed.

 **Note:** The payload must be an `object`.

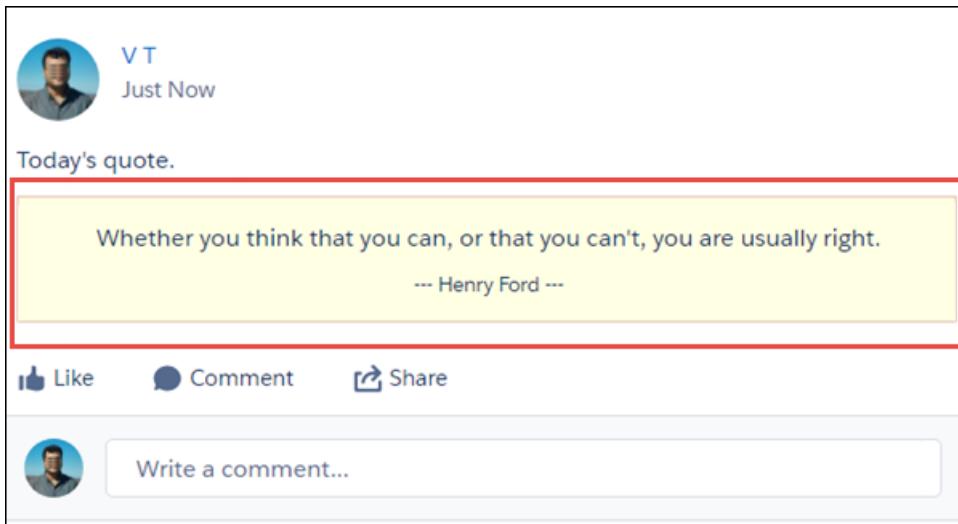
 **Example: Example of a Custom App Integrated into a Chatter Publisher**

This example shows a Chatter publisher with three custom app integrations. There are icons for a video meeting app (1), an emoji (2), and an app for selecting a daily quotation (3).



Example of a Custom App Payload in a Chatter Feed Post

This example shows the custom app's payload included in a Chatter feed.



The next sections describe how we integrated the custom quotation app with the Chatter publisher.

1. Set Up the Composer Component

For the composer component, we created component, controller, helper, and style files.

Here is the component markup in `quotesCompose cmp`. In this file, we implement the `lightning:availableForChatterExtensionComposer` interface.

```
<aura:component implements="lightning:availableForChatterExtensionComposer">
    <aura:handler name="init" value="{!this}" action=" {!c.init}"/>

    <div class="container">
        <span class="quote" aura:id="quote"></span>
        <span class="author" aura:id="author"></span>
        <ui:button label="Get next Quote" press=" {!c.getQuote}"/>
    </div>

</aura:component>
```

Use your controller and helper to initialize the composer component and to get the quote from a source. Once you get the quote, fire the event `sendChatterExtensionPayload`. Firing the event enables the **Add** button so the platform can associate the app's payload with the feed item. You can also add a title and description as metadata for the payload. The title and description are shown in a non-Lightning context, like Salesforce Classic.

```
getQuote: function(cmp, event, helper) {
    // get quote from the source
    var compEvent = cmp.getEvent("sendChatterExtensionPayload");
    compEvent.setParams({
        "payload" : "<payload object>",
        "extensionTitle" : "<title to use when extension is rendered>",
        "extensionDescription" : "<description to use when extension is rendered>"
    });
    compEvent.fire();
}
```

Add a CSS resource to your component bundle to style your composition component.

2. Set Up the Renderer Component

For the renderer component, we created component, controller, and style files.

Here is the component markup in `quotesRender.cmp`. In this file, we implement the `lightning:availableForChatterExtensionRenderer` interface, which provides the payload as an attribute in the component.

```
<aura:component implements="lightning:availableForChatterExtensionRenderer">
    <aura:attribute name="_quote" type="String"/>
    <aura:attribute name="_author" type="String"/>
    <aura:handler name="init" value="{!this}" action=" {!c.init} "/>

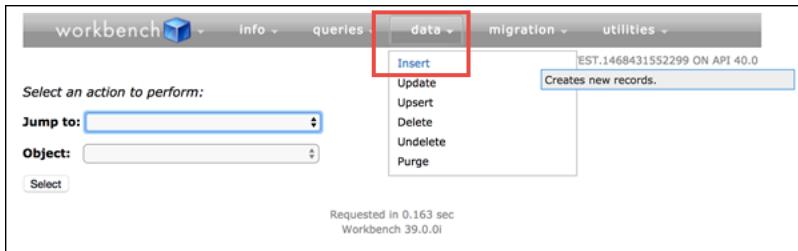
    <div class="container">
        <span class="quote" aura:id="quote">{!v._quote}</span>
        <span class="author" aura:id="author">--- {!v._author} ---</span>
    </div>
</aura:component>
```

You have a couple of ways of dealing with the payload. You can use the payload directly in the component `{ !v.payload }`. You can use your controller to parse the payload provided by the `lightning:availableForChatterExtensionRenderer` interface and set its attributes yourself. Add a CSS resource to your renderer bundle to style your renderer component.

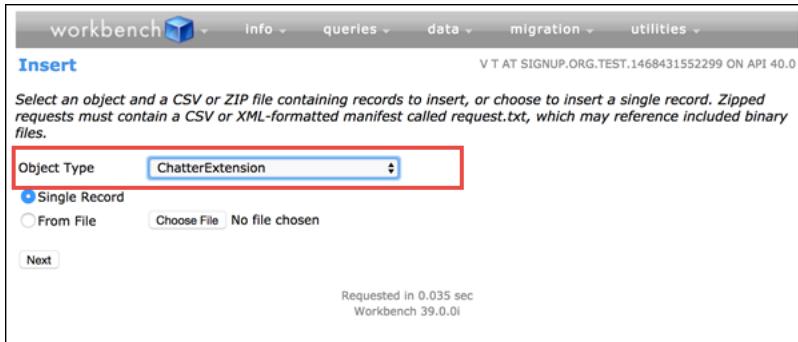
3. Set Up a New ChatterExtension Entity

After you create these components, go to [Workbench](#) (or [install your own instance](#)). Make sure that you're using at least API version 41.0. Log in to your org, and create a ChatterExtension entity.

From the Data menu, select **Insert**.



From the **Object Type** list, select *ChatterExtension*.



In the **Value** column, provide values for ChatterExtension fields (see ChatterExtension for values and descriptions).

The screenshot shows the 'Insert' screen in the Salesforce Workbench. At the top, there are tabs: workbench (selected), Info, queries, data, and migration. Below the tabs, the word 'Insert' is displayed in blue. A sub-header reads 'Provide values for the ChatterExtension fields below:'. A table lists the fields and their values:

| Field | Value | Smart Lookup |
|------------------------------|------------------------------------|--------------|
| CompositionComponentEnumOrId | 0AbR00000004I2E | |
| Description | Attach a quote with your feed item | |
| DeveloperName | sfdc_dev_name_quotes | |
| ExtensionName | Quotes | |
| HeaderText | Add a quote | |
| HoverText | Attach a quote | |
| IconId | 03SR00000004DCt | |
| IsProtected | | |
| Language | | |
| MasterLabel | Quotes | |
| RenderComponentEnumOrId | 0AbR0000000065J | |
| Type | Lightning | |

At the bottom left is a 'Confirm Insert' button.

Get the IconId for the file asset. Go to Workbench > utilities > REST Explorer and make a new POST request for creating a file asset with a fileId from your org.

The screenshot shows the 'REST Explorer' interface in the Workbench. The top bar includes tabs: workbench, info, queries, data, migration, and utilities (selected). Below the tabs, it says 'TEST USER AT SIGNUP.ORG.TEST.1500406458870 ON API 41.0'. The main area is titled 'REST Explorer' and shows a POST request being configured:

- HTTP Method: POST
- URI: /services/data/v41.0/connect/files/<fileid>/asset
- Headers: Headers, Reset, Up
- Request Body: A JSON object with an empty array: {}.
- Response: Shows a detailed JSON response for a newly created file asset. One specific field, 'id', is highlighted with a red oval.

Note: Rich Publisher Apps information is cached, so there can be a 5-minute wait before your app appears in the publisher.

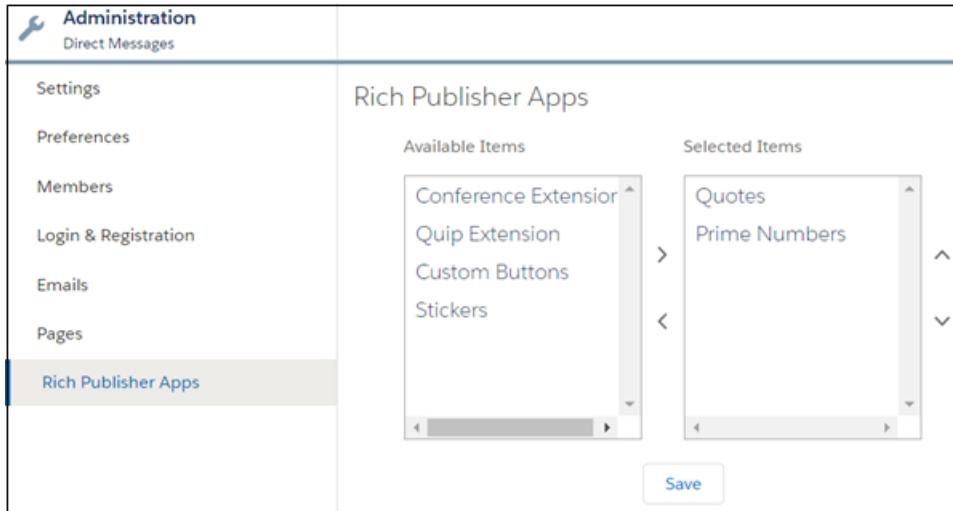
4. Package Your App and Upload It to the AppExchange

The [ISVforce Guide](#) provides useful information about packaging your apps and uploading them to the AppExchange.

5. Select the Apps to Embed in the Chatter Publisher

An admin page is available in each community for selecting and arranging the apps to show in the Chatter publisher. Select up to five apps, and arrange them in the order you like. The order you set here controls the order the app icons appear in the publisher.

In your community, go to Community Workspaces and open the Administration page. Click **Rich Publisher Apps** to open the page.



After you move apps to the Selected Items column and click **Save**, the selected apps appear in the Chatter Publisher.

Using Background Utility Items

Implement the `lightning:backgroundUtilityItem` interface to create a component that fires and responds to events without rendering in the utility bar.

This component implements `lightning:backgroundUtilityItem` and listens for `lightning:tabCreated` events when the app loads. The component prevents more than 5 tabs from opening.

```
<aura:component implements="lightning:backgroundUtilityItem">
    <aura:attribute name="limit" default="5" type="Integer" />
    <aura:handler event="lightning:tabCreated" action="{!c.onTabCreated}" />
    <lightning:workspaceAPI aura:id="workspace" />
</aura:component>
```

When a tab is created, the event handler calls `onTabCreated` in the component's controller and checks how many tabs are open. If the number of tabs is more than 5, the newly created tab automatically closes.

```
{
    onTabCreated: function(cmp) {
        var workspace = cmp.find("workspace");
        var limit = cmp.get("v.limit");
        workspace.getAllTabInfo().then(function (tabInfo) {
            if (tabInfo.length > limit) {
                workspace.closeTab({
                    tabId: tabInfo[0].tabId
                });
            }
        });
    };
}
```

```
}
```

Background utility items are added to an app the same way normal utility items are, but they don't appear in the utility bar. The  icon appears next to background utility items on the utility item list.

Use Lightning Components in Visualforce Pages

Add Aura components to your Visualforce pages to combine features you've built using both solutions. Implement new functionality using Aura components and then use it with existing Visualforce pages.

 **Important:** Lightning Components for Visualforce is based on Lightning Out, a powerful and flexible feature that lets you embed Aura components into almost any web page. When used with Visualforce, some of the details become simpler. For example, you don't need to deal with authentication, and you don't need to configure a Connected App.

In other ways using Lightning Components for Visualforce is just like using Lightning Out. Refer to the Lightning Out section of this guide for additional details.

There are three steps to add Aura components to a Visualforce page.

1. Add the Lightning Components for Visualforce JavaScript library to your Visualforce page using the `<apex:includeLightning/>` component.
2. Create and reference a Lightning app that declares your component dependencies.
3. Write a JavaScript function that creates the component on the page using `$Lightning.createComponent()`.

Add the Lightning Components for Visualforce JavaScript Library

Add `<apex:includeLightning/>` at the beginning of your page. This component loads the JavaScript file used by Lightning Components for Visualforce.

Create and Reference a Lightning Dependency App

To use Lightning Components for Visualforce, define component dependencies by referencing a Lightning dependency app. This app is globally accessible and extends `ltng:outApp`. The app declares dependencies on any Lightning definitions (like components) that it uses.

Here's an example of a Lightning app named `lcvfTest.app`. The app uses the `<aura:dependency>` tag to indicate that it uses the standard Lightning component, `lightning:button`.

```
<aura:application access="GLOBAL" extends="ltng:outApp">
  <aura:dependency resource="lightning:button"/>
</aura:application>
```

 **Note:** Extending from `ltng:outApp` adds SLDS resources to the page to allow your Lightning components to be styled with the Salesforce Lightning Design System (SLDS). If you don't want SLDS resources added to the page, extend from `ltng:outAppUnstyled` instead.

To reference this app on your page, use the following JavaScript code, where `theNamespace` is the namespace prefix for the app. That is, either your org's namespace, or the namespace of the managed package that provides the app.

```
$Lightning.use("theNamespace:lcvfTest", function() {});
```

If the app is defined in your org (that is, not in a managed package), you can use the default “c” namespace instead, as shown in the next example. If your org doesn’t have a namespace defined, you *must* use the default namespace.

For further details about creating a Lightning dependency app, see [Lightning Out Dependencies](#).

Creating a Component on a Page

Finally, add your top-level component to a page using `$Lightning.createComponent(String type, Object attributes, String domLocator, function callback)`. This function is similar to `$A.createComponent()`, but includes an additional parameter, `domLocator`, which specifies the DOM element where you want the component inserted.

Let’s look at a sample Visualforce page that creates a `lightning:button` using the `lcvfTest.app` from the previous example.

```
<apex:page>
    <apex:includeLightning />

    <div id="lightning" />

    <script>
        $Lightning.use("c:lcvfTest", function() {
            $Lightning.createComponent("lightning:button",
                { label : "Press Me!" },
                "lightning",
                function(cmp) {
                    console.log("button was created");
                    // do some stuff
                }
            );
        });
    </script>
</apex:page>
```

The `$Lightning.createComponent()` call creates a button with a “Press Me!” label. The button is inserted in a DOM element with the ID “lightning”. After the button is added and active on the page, the callback function is invoked and executes a `console.log()` statement. The callback receives the component created as its only argument. In this simple example, the button isn’t configured to do anything.

! **Important:** You can call `$Lightning.use()` multiple times on a page, but all calls must reference the same Lightning dependency app.

For further details about using `$Lightning.use()` and `$Lightning.createComponent()`, see [Lightning Out Markup](#).

SEE ALSO:

[Lightning Out Dependencies](#)

[Add Aura Components to Any App with Lightning Out \(Beta\)](#)

[Lightning Out Markup](#)

[Share Lightning Out Apps with Non-Authenticated Users](#)

[Lightning Out Considerations and Limitations](#)

Add Aura Components to Any App with Lightning Out (Beta)

Use Lightning Out to run Aura component apps outside of Salesforce servers. Whether it's a Node.js app running on Heroku, a department server inside the firewall, or even SharePoint, build your custom app with Lightning Platform and run it wherever your users are.



Note: This release contains a beta version of Lightning Out, which means it's a high quality feature with known limitations. You can provide feedback and suggestions for Lightning Out on the [IdeaExchange](#).

Developing Aura components that you can deploy anywhere is for the most part the same as developing them to run within Salesforce. Everything you already know about Aura component development still applies. The only real difference is how you embed your app in the remote web container, or *origin server*.

Lightning Out is added to external apps in the form of a JavaScript library you include in the page on the origin server, and markup you add to configure and activate your Lightning components app. Once initialized, Lightning Out pulls in your Lightning components app over a secure connection, spins it up, and inserts it into the DOM of the page it's running on. Once it reaches this point, your "normal" Lightning components code takes over and runs the show.



Note: This approach is quite different from embedding an app using an iframe. Aura components running via Lightning Out are full citizens on the page. If you choose to, you can enable interaction between your Lightning components app and the page or app you've embedded it in. This interaction is handled using Lightning events.

In addition to some straightforward markup, there's a modest amount of setup and preparation within Salesforce to enable the secure connection between Salesforce and the origin server. And, because the origin server is hosting the app, you need to manage authentication with your own code.

This setup process is similar to what you'd do for an application that connects to Salesforce using the Lightning Platform REST API, and you should expect it to require an equivalent amount of work.

IN THIS SECTION:

[Lightning Out Requirements](#)

Deploying a Lightning components app using Lightning Out has a few modest requirements to ensure connectivity and security.

[Lightning Out Dependencies](#)

Create a special Lightning dependency app to describe the component dependencies of a Lightning components app to be deployed using Lightning Out or Lightning Components for Visualforce.

[Lightning Out Markup](#)

Lightning Out requires some simple markup on the page, and is activated using two straightforward JavaScript functions.

[Authentication from Lightning Out](#)

Lightning Out doesn't handle authentication. Instead, you manually provide a Salesforce session ID or authentication token when you initialize a Lightning Out app.

[Share Lightning Out Apps with Non-Authenticated Users](#)

Add the `lntng:allowGuestAccess` interface to your Lightning Out dependency app to make it available to users without requiring them to authenticate with Salesforce. This interface lets you build your app with Aura components, and deploy it anywhere and to anyone.

Lightning Out Considerations and Limitations

Creating an app using Lightning Out is, for the most part, much like creating any app with Lightning components. However, because your components are running “outside” of Salesforce, there are a few issues you want to be aware of. And it’s possible there are changes you might need to make to your components or your app.

SEE ALSO:

[Idea Exchange: Lightning Components Anywhere / Everywhere](#)

Lightning Out Requirements

Deploying a Lightning components app using Lightning Out has a few modest requirements to ensure connectivity and security.

The remote web container, or *origin server*, must support the following.

- Ability to modify the markup served to the client browser, including both HTML and JavaScript. You need to be able to add the Lightning Out markup.
- Ability to acquire a valid Salesforce session ID. This will most likely require you to configure a Connected App for the origin server.
- Ability to access your Salesforce instance. For example, if the origin server is behind a firewall, it needs permission to access the Internet, at least to reach Salesforce.

Your Salesforce org must be configured to allow the following.

- The ability for the origin server to authenticate and connect. This will most likely require you to configure a Connected App for the origin server.
- The origin server must be added to the Cross-Origin Resource Sharing (CORS) whitelist.

Finally, you create a special Lightning components app that contains dependency information for the Lightning components to be hosted on the origin server. This app is only used by Lightning Out or Lightning Components for Visualforce.

Lightning Out Dependencies

Create a special Lightning dependency app to describe the component dependencies of a Lightning components app to be deployed using Lightning Out or Lightning Components for Visualforce.

When a Lightning components app is initialized using Lightning Out, Lightning Out loads the definitions for the components in the app. To do this efficiently, Lightning Out requires you to specify the component dependencies in advance, so that the definitions can be loaded once, at startup time.

The mechanism for specifying dependencies is a *Lightning dependency app*. A dependency app is simply an `<aura:application>` with a few attributes, and the dependent components described using the `<aura:dependency>` tag. A Lightning dependency app isn’t one you’d ever actually deploy as an app for people to use directly. **A Lightning dependency app is used only to specify the dependencies for Lightning Out.** (Or for Lightning Components for Visualforce, which uses Lightning Out under the covers.)

A basic Lightning dependency app looks like the following.

```
<aura:application access="GLOBAL" extends="ltng:outApp">
    <aura:dependency resource="c:myAppComponent"/>
</aura:application>
```

A Lightning dependency app must do the following.

- Set access control to GLOBAL.
- Extend from either `ltng:outApp` or `ltng:outAppUnstyled`.
- List as a dependency every component that is referenced in a call to `$Lightning.createComponent()`.

In this example, `<c:myAppComponent>` is the top-level component for the Lightning components app you are planning to create on the origin server using `$Lightning.createComponent()`. Create a dependency for each different component you add to the page with `$Lightning.createComponent()`.



Note: Don't worry about components used within the top-level component. The Lightning Component framework handles dependency resolution for child components.

Defining a Styling Dependency

You have two options for styling your Lightning Out apps: Salesforce Lightning Design System and unstyled. Lightning Design System styling is the default, and Lightning Out automatically includes the current version of the Lightning Design System onto the page that's using Lightning Out. To omit Lightning Design System resources and take full control of your styles, perhaps to match the styling of the origin server, set your dependency app to extend from `ltng:outAppUnstyled` instead of `ltng:outApp`.

Usage Notes

A Lightning dependency app isn't a normal Lightning app, and you shouldn't treat it like one. Use it only to specify the dependencies for your Lightning Out app.

In particular, note the following.

- You can't add a template to a Lightning dependency app.
- Content you add to the body of the Lightning dependency app won't be rendered.

SEE ALSO:

[Create a Connected App](#)

[Use CORS to Access Salesforce Resources from Web Browsers](#)

[aura:dependency](#)

[Using the Salesforce Lightning Design System in Apps](#)

Lightning Out Markup

Lightning Out requires some simple markup on the page, and is activated using two straightforward JavaScript functions.

The markup and JavaScript functions in the Lightning Out library are the only things specific to Lightning Out. Everything else is the Lightning components code you already know and love.

Adding the Lightning Out Library to the Page

Enable an origin server for use with Lightning Out by including the Lightning Out JavaScript library in the app or page hosting your Lightning components app. Including the library requires a single line of markup.

```
<script src="https://myDomain.my.salesforce.com/lightning/lightning.out.js"></script>
```



Important: Use **your** custom domain for the host. Don't copy-and-paste someone else's instance from example source code. If you do this, your app will break whenever there's a version mismatch between your Salesforce instance and the instance from which you're loading the Lightning Out library. This happens at least three times a year, during regular upgrades of Salesforce. Don't do it!

Loading and Initializing Your Lightning Components App

Load and initialize the Lightning Component framework and your Lightning components app with the `$Lightning.use()` function.

The `$Lightning.use()` function takes four arguments.

| Name | Type | Description |
|----------------------|----------|--|
| appName | string | Required. The name of your Lightning dependency app, including the namespace. For example, "c:expenseAppDependencies". |
| callback | function | A function to call once the Lightning Component framework and your app have fully loaded. The callback receives no arguments. This callback is usually where you call <code>\$Lightning.createComponent()</code> to add your app to the page (see the next section). You might also update your display in other ways, or otherwise respond to your Lightning components app being ready. |
| lightningEndPointURI | string | The URL for the Lightning domain on your Salesforce instance. For example, <code>https://myDomain.lightning.force.com</code> . |
| authToken | string | The session ID or OAuth access token for a valid, active Salesforce session.  Note: You must obtain this token in your own code. Lightning Out doesn't handle authentication for you. See Authentication from Lightning Out . |

`appName` is required. The other three parameters are optional. In normal use you provide all four parameters.

 **Note:** You can't use more than one Lightning dependency app on a page. You can call `$Lightning.use()` more than once, but you must reference the same dependency app in every call.

Adding Your Aura Components to the Page

Add to and activate your Aura components on the page with the `$Lightning.createComponent()` function.

The `$Lightning.createComponent()` function takes four arguments.

| Name | Type | Description |
|---------------|-------------------|---|
| componentName | string | Required. The name of the Aura component to add to the page, including the namespace. For example, "c:newExpenseForm". |
| attributes | Object | Required. The attributes to set on the component when it's created. For example, <code>{ name: theName, amount: theAmount }</code> . If the component doesn't require any attributes, pass in an empty object, <code>{ }</code> . |
| domLocator | Element or string | Required. The DOM element or element ID that indicates where on the page to insert the created component. |
| callback | function | A function to call once the component is added to and active on the page. The callback receives the component created as its only argument. |

 **Note:** You can add more than one Aura component to a page. That is, you can call `$Lightning.createComponent()` multiple times, with multiple DOM locators, to add components to different parts of the page. Each component created this way must be specified in the page's Lightning dependency app.

Behind the scenes `$Lightning.createComponent()` calls the standard `$A.createComponent()` function. Except for the DOM locator, the arguments are the same. And except for wrapping the call in some Lightning Out semantics, the behavior is the same, too.

SEE ALSO:

[Dynamically Creating Components](#)

Authentication from Lightning Out

Lightning Out doesn't handle authentication. Instead, you manually provide a Salesforce session ID or authentication token when you initialize a Lightning Out app.

There are two supported ways to obtain an authentication token for use with Lightning Out.

- On a Visualforce page, using Lightning Components for Visualforce, you can obtain the current Visualforce session ID using the expression `{! $Api.Session_ID }`. Sessions initiated using the session ID are intended for use only on Visualforce pages.
- Elsewhere, an authenticated session is obtained using OAuth, following the same process you'd use to obtain an authenticated session to use with the REST API. In this case, you obtain an OAuth token, and can use it anywhere.

 **Important:** Lightning Out isn't in the business of authentication. The `$Lightning.use()` function simply passes along to the security subsystem whatever authentication token you provide. For most organizations, the token is a session ID or an OAuth token.

Lightning Out has the same privileges as the session from which you obtain the authentication token. For Visualforce using `{! $Api.Session_ID }`, the session has the privileges of the current user. For OAuth it's whatever OAuth scope setting that the OAuth Connected App is defined with. Usually, using Lightning Out with OAuth requires you to grant "Full Access" scope to the Connected App returning the OAuth token.

When a Lightning Out authenticated session is granted with a session access token, the session persists access to any lightning.force.com domain running in the active browser session. Once a user is logged in with a valid access token, the session credentials are validated across all Salesforce applications running in the active browser session.

To prevent session persistence, system administrators can lock the session to the originating IP address. To select this option, navigate to:

Setup > Security > Session Settings

Activate the **Lock sessions to the IP address from which they originated** check box.



Share Lightning Out Apps with Non-Authenticated Users

Add the `ltng:allowGuestAccess` interface to your Lightning Out dependency app to make it available to users without requiring them to authenticate with Salesforce. This interface lets you build your app with Aura components, and deploy it anywhere and to anyone.

A Lightning Out dependency app with the `ltng:allowGuestAccess` interface can be used with Lightning Components for Visualforce and with Lightning Out.

- Using Lightning Components for Visualforce, you can add your Lightning app to a Visualforce page, and then use that page in Salesforce Tabs + Visualforce communities. Then you can allow public access to that page.
- Using Lightning Out, you can deploy your Lightning app anywhere Lightning Out is supported—which is almost anywhere!

The `ltng:allowGuestAccess` interface is only usable in orgs that have Communities enabled, and your Lightning Out app is associated with all community endpoints that you've defined in your org.

 **Important:** When you make a Lightning app accessible to guest users by adding the `ltng:allowGuestAccess` interface, it's available through **every** community in your org, whether that community is enabled for public access or not. You can't prevent it from being accessible via community URLs, and you can't make it available for some communities but not others.

 **Warning:** Be extremely careful about apps you open for guest access. Apps enabled for guest access bypass the object- and field-level security (FLS) you set for your community's guest user profile. Aura components don't automatically enforce CRUD and FLS when you reference objects or retrieve the objects from an Apex controller. This means that the framework continues to display records and fields for which users don't have CRUD access and FLS visibility. You must manually enforce CRUD and FLS in your Apex controllers. A mistake in code used in an app enabled for guest access can open your org's data to the world.

Lightning Out Lightning Components for Visualforce

Usage

To begin with, add the `ltng:allowGuestAccess` interface to your Lightning Out dependency app. For example:

```
<aura:application access="GLOBAL" extends="ltng:outApp"
    implements="ltng:allowGuestAccess">

    <aura:dependency resource="c:storeLocatorMain"/>

</aura:application>
```

 **Note:** You can only add the `ltng:allowGuestAccess` interface to Lightning apps, not to individual components.

Next, add the Lightning Out JavaScript library to your page.

- With Lightning Components for Visualforce, simply add the `<apex:includeLightning />` tag anywhere on your page.
- With Lightning Out, add a `<script>` tag that references the library directly, using a community endpoint URL. For example:

```
<script
src="https://yourCommunityDomain/communityURL/lightning/lightning.out.js"></script>
```

For example, `https://universalcontainers.force.com/ourstores/lightning/lightning.out.js`

Finally, add the JavaScript code to load and activate your Lightning app. This code is standard Lightning Out, with the important addition that you must use one of your org's community URLs for the endpoint. The endpoint URL takes the form `https://yourCommunityDomain/communityURL/`. The relevant line is emphasized in the following sample.

```
<script>
    $Lightning.use("c:locatorApp",      // name of the Lightning app
        function() {                  // Callback once framework and app loaded
            $Lightning.createComponent(
                "c:storeLocatorMain",   // top-level component of your app
                {},                      // attributes to set on the component when created
                "lightningLocator",     // the DOM location to insert the component
                function(cmp) {
                    // callback when component is created and active on the page
                }
            );
        },
        'https://universalcontainers.force.com/ourstores/' // Community endpoint
    );
</script>
```

SEE ALSO:

[Salesforce Help: Create Communities](#)

[Use Lightning Components in Visualforce Pages](#)

Lightning Out Considerations and Limitations

Creating an app using Lightning Out is, for the most part, much like creating any app with Lightning components. However, because your components are running “outside” of Salesforce, there are a few issues you want to be aware of. And it’s possible there are changes you might need to make to your components or your app.

The issues you should be aware of can be divided into two categories.

Considerations for Using Lightning Out

Because Lightning Out apps run outside of any Salesforce container, there are things you need to keep in mind, and possibly address.

First, Lightning components depend on setting cookies in a user’s browser. Since Lightning Out runs Lightning components *outside* of Salesforce, those cookies are “third-party” cookies. Your users need to allow third-party cookies in their browser settings.

The most significant and obvious issue is authentication. There’s no Salesforce container to handle authentication for you, so you have to handle it yourself. This essential topic is discussed in detail in “Authentication from Lightning Out.”

Another important consideration is more subtle. Many important actions your apps support are accomplished by firing various Lightning events. But events are sort of like that tree that falls in the forest. If no one’s listening, does it have an effect? In the case of many core Lightning events, the “listener” is the Lightning Experience or Salesforce app container, `one.app`. And if `one.app` isn’t there to handle the events, they indeed have no effect. Firing those events silently fails.

Standard events are listed in the Component Library. Events not supported in Lightning Out include text similar to the following in the Documentation tab:

 **Note:** This event is handled by the `one.app` container. It’s supported in Lightning Experience and Salesforce app only.

Lightning Out doesn’t support the Lightning Console JavaScript API.

Limitations With Standard Components

While the core Lightning Out functionality is stable and complete, there are a few interactions with other Salesforce features that we're still working on.

Chief among these is the standard components built into the Lightning Component framework. Many standard components don't behave correctly when used in a stand-alone context, such as Lightning Out, and Lightning Components for Visualforce, which is based on Lightning Out. This is because the components implicitly depend on resources available in the `one.app` container.

Avoid this issue with your own components by making all of their dependencies explicit. Use `lntng:require` to reference all required JavaScript and CSS resources that aren't embedded in the component itself.

If you're using standard components in your apps, they might not be fully styled, or behave as documented, when they're used in Lightning Out or Lightning Components for Visualforce.

SEE ALSO:

[Browser Support Considerations for Lightning Components](#)

[Component Library](#)

[Authentication from Lightning Out](#)

[Use Lightning Components in Visualforce Pages](#)

Lightning Container

Upload an app developed with a third-party framework as a static resource, and host the content in an Aura component using `lightning:container`. Use `lightning:container` to use third-party frameworks like AngularJS or React within your Lightning pages.

The `lightning:container` component hosts content in an iframe. You can implement communication to and from the framed application, allowing it to interact with the Lightning component. `lightning:container` provides the `message()` method, which you can use in the JavaScript controller to send messages to the application. In the component, specify a method for handling messages with the `onmessage` attribute.

IN THIS SECTION:

[Lightning Container Component Limits](#)

Understand the limits of `lightning:container`.

[The Lightning Realty App](#)

The Lightning Realty App is a more robust example of messaging between the Lightning Container Component and Salesforce.

[lightning-container NPM Module Reference](#)

Use methods included in the `lightning-container` NPM module in your JavaScript code to send and receive messages to and from your custom Aura component, and to interact with the Salesforce REST API.

Using a Third-Party Framework

`lightning:container` allows you to use an app developed with a third-party framework, such as AngularJS or React, in an Aura component. Upload the app as a static resource.

Your application must have a launch page, which is specified with the `lightning:container src` attribute. By convention, the launch page is `index.html`, but you can specify another launch page by adding a manifest file to your static resource. The following

example shows a simple Aura component that references `myApp`, an app uploaded as a static resource, with a launch page of `index.html`.

```
<aura:component>
    <lightning:container src="{!$Resource.myApp + '/index.html'}" />
</aura:component>
```

The contents of the static resource are up to you. It should include the JavaScript that makes up your app, any associated assets, and a launch page.

As in other Aura components, you can specify custom attributes. This example references the same static resource, `myApp`, and has three attributes, `messageToSend`, `messageReceived`, and `error`. Because this component includes `implements="flexipage:availableForAllPageTypes"`, it can be used in the Lightning App Builder and added to Lightning pages.

 **Note:** The examples in this section are accessible on the [Developerforce Github Repository](#).

```
<aura:component access="global" implements="flexipage:availableForAllPageTypes" >
    <aura:attribute access="private" name="messageToSend" type="String" default="" />
    <aura:attribute access="private" name="messageReceived" type="String" default="" />
    <aura:attribute access="private" name="error" type="String" default="" />

    <div>
        <lightning:input name="messageToSend" value="{!v.messageToSend}" label="Message to send to React app: "/>
        <lightning:button label="Send" onclick=" {!c.sendMessage} "/>
        <br/>
        <lightning:textarea value="{!v.messageReceived}" label="Message received from React app: "/>
        <br/>
        <aura:if isTrue=" {! !empty(v.error) } ">
            <lightning:textarea name="errorTextArea" value="{!v.error}" label="Error: " />
        </aura:if>

        <lightning:container aura:id="ReactApp"
            src="{!$Resource.SendReceiveMessages + '/index.html'}"
            onmessage=" {!c.handleMessage} "
            onerror=" {!c.handleError} "/>
    </div>
</aura:component>
```

The component includes a `lightning:input` element, allowing users to enter a value for `messageToSend`. When a user hits **Send**, the component calls the controller method `sendMessage`. This component also provides methods for handling messages and errors.

This snippet doesn't include the component's controller or other code, but don't worry. We'll dive in, break it down, and explain how to implement message and error handling as we go in [Sending Messages from the Lightning Container Component](#) and [Handling Errors in Your Container](#).

SEE ALSO:

[Lightning Container](#)

[Sending Messages from the Lightning Container Component](#)

[Handling Errors in Your Container](#)

Sending Messages from the Lightning Container Component

Use the `onmessage` attribute of `lightning:container` to specify a method for handling messages to and from the contents of the component—that is, the embedded app. The contents of `lightning:container` are wrapped within an iframe, and this method allows you to communicate across the frame boundary.

This example shows an Aura component that includes `lightning:container` and has three attributes, `messageToSend`, `messageReceived`, and `error`.

This example uses the same code as the one in [Using a Third-Party Framework](#). You can download the complete version of this example from the [Developerforce Github Repository](#).

```
<aura:component access="global" implements="flexipage:availableForAllPageTypes" >
    <aura:attribute access="private" name="messageToSend" type="String" default="" />
    <aura:attribute access="private" name="messageReceived" type="String" default="" />
    <aura:attribute access="private" name="error" type="String" default="" />

    <div>
        <lightning:input name="messageToSend" value="{!v.messageToSend}" label="Message to send to React app: "/>
        <lightning:button label="Send" onclick=" {!c.sendMessage} "/>
        <br/>
        <lightning:textarea value="{!v.messageReceived}" label="Message received from React app: "/>
        <br/>
        <aura:if isTrue=" {! !empty(v.error)} ">
            <lightning:textarea name="errorTextArea" value="{!v.error}" label="Error: "/>
        </aura:if>

        <lightning:container aura:id="ReactApp"
            src=" {!$Resource.SendReceiveMessages + '/index.html'} "
            onmessage=" {!c.handleMessage}"
            onerror=" {!c.handleError} "/>
    </div>
</aura:component>
```

`messageToSend` represents a message sent from Salesforce to the framed app, while `messageReceived` represents a message sent by the app to the Aura component. `lightning:container` includes the required `src` attribute, an `aura:id`, and the `onmessage` attribute. The `onmessage` attribute specifies the message-handling method in your JavaScript controller, and the `aura:id` allows that method to reference the component.

This example shows the component's JavaScript controller.

```
{
    sendMessage : function(component, event, helper) {
        var msg = {
            name: "General",
            value: component.get("v.messageToSend")
        };
        component.find("ReactApp").message(msg);
    },
    handleMessage: function(component, message, helper) {
        var payload = message.getParams().payload;
```

```

    var name = payload.name;
    if (name === "General") {
        var value = payload.value;
        component.set("v.messageReceived", value);
    }
    else if (name === "Foo") {
        // A different response
    }
}

handleError: function(component, error, helper) {
    var e = error;
}
})
)

```

This code does a couple of different things. The `sendMessage` action sends a message from the enclosing Aura component to the embedded app. It creates a variable, `msg`, that has a JSON definition including a `name` and a `value`. This definition of the message is user-defined—the message’s payload can be a value, a structured JSON response, or something else. The `messageToSend` attribute of the Aura component populates the `value` of the message. The method then uses the component’s `aura:id` and the `message()` function to send the message back to the Aura component.

The `handleMessage` method receives a message from the embedded app and handles it appropriately. It takes a component, a message, and a helper as arguments. The method uses conditional logic to parse the message. If this is the message with the `name` and `value` we’re expecting, the method sets the Aura component’s `messageReceived` attribute to the `value` of the message. Although this code only defines one message, the conditional statement allows you to handle different types of message, which are defined in the `sendMessage` method.

The handler code for sending and receiving messages can be complicated. It helps to understand the flow of a message between the Aura component, its controller, and the app. The process begins when user enters a message as the `messageToSend` attribute. When the user clicks **Send**, the component calls `sendMessage`. `sendMessage` defines the message payload and uses the `message()` method to send it to the app. Within the static resource that defines the app, the specified message handler function receives the message. Specify the message handling function within your JavaScript code using the `lightning-container` module’s `addMessageHandler()` method. See the [lightning-container NPM Module Reference](#) for more information.

When `lightning:container` receives a message from the framed app, it calls the component controller’s `handleMessage` method, as set in the `onmessage` attribute of `lightning:container`. The `handleMessage` method takes the message, and sets its value as the `messageReceived` attribute. Finally, the component displays `messageReceived` in a `lightning:textarea`.

This is a simple example of message handling across the container. Because you implement the controller-side code and the functionality of the app, you can use this functionality for any kind of communication between Salesforce and the app embedded in `lightning:container`.

! **Important:** Don’t send cryptographic secrets like an API key in a message. It’s important to keep your API key secure.

SEE ALSO:

- [Lightning Container](#)
- [Using a Third-Party Framework](#)
- [Handling Errors in Your Container](#)

Sending Messages to the Lightning Container Component

Use the methods in the lightning-container NPM module to send messages from the JavaScript code framed by lightning:container.

The Lightning-container NPM module provides methods to send and receive messages between your JavaScript app and the Lightning container component. You can see the lightning-container module on the NPM [website](#).

Add the lightning-container module as a dependency in your code to implement the messaging framework in your app.

```
import LCC from 'lightning-container';
```

lightning-container must also be listed as a dependency in your app's package.json file.

The code to send a message to lightning:container from the app is simple. This code corresponds to the code samples in [Sending Messages from the Lightning Container Component](#) and [Handling Errors in Your Container](#), and can be downloaded from the [Developerforce Github Repository](#).

```
sendMessage() {
    LCC.sendMessage({name: "General", value: this.state.messageToSend});
}
```

This code, part of the static resource, sends a message as an object containing a name and a value, which is user-defined.

When the app receives a message, it's handled by the function mounted by the addMessageHandler() method. In a React app, functions must be mounted to be part of the document-object model and rendered in the output.

The lightning-container module provides similar methods for defining a function to handle errors in the messaging framework. For more information, see [lightning-container NPM Module Reference](#)

! **Important:** Don't send cryptographic secrets like an API key in a message. It's important to keep your API key secure.

Handling Errors in Your Container

Handle errors in Lightning container with a method in your component's controller.

This example uses the same code as the examples in [Using a Third-Party Framework](#) and [Sending Messages from the Lightning Container Component](#).

In this component, the onerror attribute of lightning:container specifies handleError as the error handling method. To display the error, the component markup uses a conditional statement, and another attribute, error, for holding an error message.

```
<aura:component access="global" implements="flexipage:availableForAllPageTypes" >

    <aura:attribute access="private" name="messageToSend" type="String" default="" />
    <aura:attribute access="private" name="messageReceived" type="String" default="" />
    <aura:attribute access="private" name="error" type="String" default="" />

    <div>
        <lightning:input name="messageToSend" value="{!v.messageToSend}" label="Message to send to React app: "/><lightning:button label="Send" onclick=" {!c.sendMessage} "/>

        <br/>

        <lightning:textarea name="messageReceived" value="{!v.messageReceived}" label="Message received from React app: "/>

        <br/>
```

```

<aura:if isTrue=" {! !empty(v.error) } " >
    <lightning:textarea name="errorMessage" value=" {!v.error} " label="Error: "/>
</aura:if>

<lightning:container aura:id="ReactApp"
    src=" {!$Resource.SendReceiveMessages + '/index.html'} "
    onmessage=" {!c.handleMessage} "
    onerror=" {!c.handleError} "/>

</div>

</aura:component>

```

This is the component's controller.

```

({
    sendMessage : function(component, event, helper) {

        var msg = {
            name: "General",
            value: component.get("v.messageToSend")
        };
        component.find("ReactApp").message(msg);
    },

    handleMessage: function(component, message, helper) {
        var payload = message.getParams().payload;
        var name = payload.name;
        if (name === "General") {
            var value = payload.value;
            component.set("v.messageReceived", value);
        }
        else if (name === "Foo") {
            // A different response
        }
    },
    handleError: function(component, error, helper) {
        var description = error.getParams().description;
        component.set("v.error", description);
    }
})

```

If the Lightning container application throws an error, the error handling function sets the `error` attribute. Then, in the component markup, the conditional expression checks if the `error` attribute is empty. If it isn't, the component populates a `lightning:textarea` element with the error message stored in `error`.

SEE ALSO:

[Lightning Container](#)

[Using a Third-Party Framework](#)

[Sending Messages from the Lightning Container Component](#)

Using Apex Services from Your Container

Use the `lightning-container` NPM module to call Apex methods from your Lightning container component.

To call Apex methods from `lightning:container`, you must set the CSP level to `low` in the `manifest.json` file. A CSP level of `low` allows the Lightning container component load resources from outside of the Lightning domain.

This is an Aura component that includes a Lightning container component that uses Apex services:

```
<aura:component access="global" implements="flexipage:availableForAllPageTypes">

    <aura:attribute access="private" name="error" type="String" default="" />

    <div>
        <aura:if isTrue=" {! !empty(v.error) } " >
            <lightning:textarea name="errorTextArea" value=" {!v.error} " label="Error: " />
        </aura:if>

        <lightning:container aura:id="ReactApp"
            src="/ApexController/index.html"
            onerror=" {!c.handleError} " />
    </div>

</aura:component>
```

This is the component's controller:

```
({
    handleError: function(component, error, helper) {
        var description = error.getParams().description;
        component.set("v.error", description);
    }
})
```

 **Note:** You can download the complete version of this example from the [Developerforce Github Repository](#).

There's not a lot going on in the component's JavaScript controller—the real action is in the JavaScript app, uploaded as a static resource, that the Lightning container references.

```
import React, { Component } from 'react';
import LCC from "lightning-container";
import logo from './logo.svg';
import './App.css';

class App extends Component {

    callApex() {
        LCC.callApex("lcc1.ApexController.getAccount",
            this.state.name,
            this.handleAccountQueryResponse,
            {escape: true});
    }

    handleAccountQueryResponse(result, event) {
        if (event.status) {
            this.setState({account: result});
        }
    }
}
```

```

        }
    else if (event.type === "exception") {
        console.log(event.message + " : " + event.where);
    }
}

render() {
    var account = this.state.account;

    return (
        <div className="App">
            <div className="App-header">
                <img src={logo} className="App-logo" alt="logo" />
                <h2>Welcome to LCC</h2>
            </div>
            <p className="App-intro">
                Account Name: <input type="text" id="accountName" value={this.state.name}>
                onChange={e => this.onAccountNameChange(e)}/><br/>
                <input type="submit" value="Call Apex Controller" onClick={this.callApex}/><br/>

                Id: {account.Id}<br/>
                Phone: {account.Phone}<br/>
                Type: {account.Type}<br/>
                Number of Employees: {account.NumberOfEmployees}<br/>
            </p>
        </div>
    );
}

constructor(props) {
    super(props);
    this.state = {
        name: "",
        account: {}
    };

    this.handleAccountQueryResponse = this.handleAccountQueryResponse.bind(this);
    this.onAccountNameChange = this.onAccountNameChange.bind(this);
    this.callApex = this.callApex.bind(this);
}

onAccountNameChange(e) {
    this.setState({name: e.target.value});
}
}

export default App;

```

The first function, `callApex()`, uses the `LCC.callApex` method to call `getAccount`, an Apex method that gets and displays an account's information.

Lightning Container Component Limits

Understand the limits of `lightning:container`.

`lightning:container` has known limitations. You might observe performance and scrolling issues associated with the use of iframes. This component isn't designed for the multi-page model, and it doesn't integrate with browser navigation history.

If you navigate away from the page and a `lightning:container` component is on, the component doesn't automatically remember its state. The content within the iframe doesn't use the same offline and caching schemes as the rest of Lightning Experience.

Creating a Lightning app that loads a Lightning container static resource from another namespace is not supported. If you install a package, your apps should use the custom Lightning components published by that package, not their static resources directly. Any static resource you use as the `lightning:container src` attribute should have your own namespace.

Previous versions of `lightning:container` allowed developers to specify the Content Security Policy (CSP) of the iframed content. We removed this functionality for security reasons. The CSP level of all pages is now set to `high`. This value provides the greatest security, because content can only be loaded from secure, approved domains. When `lightning:container` is used in Communities, the CSP setting in that community will be respected.

Apps that use `lightning:container` should work with data, not metadata. Don't use the session key for your app to manage custom objects or fields. You can use the session key to create and update object records.

Content in `lightning:container` is served from the Lightning container domain and is available in Lightning Experience, Lightning Communities, and the Salesforce mobile app. `lightning:container` can't be used in Lightning pages that aren't served from the Lightning domain, such as Visualforce pages or in external apps through Lightning Out.

IN THIS SECTION:

[Lightning Container Component Security Requirements](#)

Ensure that your Lightning container components meet security requirements.

SEE ALSO:

[Lightning Container](#)

[Salesforce Help: Content Security Policy in Communities](#)

Lightning Container Component Security Requirements

Ensure that your Lightning container components meet security requirements.

Namespace Validity

The Lightning container component's security measures check the validity of its namespaces. Suppose that you develop a `<lightning:container>` component with the namespace "vendor1." The static resource's namespace must also be "vendor1." If they don't match, an error message appears.

```
<aura:component>
  <lightning:container
    src=" {!$Resource.vendor1__resource + '/code_belonging_to_vendor1'} "
    onmessage=" {!c.vendor1__handles}"/>
<aura:component>
```

Static Resource Content Access

You can't use raw `<iframe>` elements to access a Lightning container component. The `<lightning:container>` component enforces this requirement with the query parameter `_CONFIRMATIONTOKEN`, which generates a unique ID for each user session. The following code isn't permitted, because the `<iframe>` `src` attribute doesn't contain a `_CONFIRMATIONTOKEN` query parameter.

```
<aura:component>
  <iframe
    src="https://domain--vendor2.container.lightning.com/lcc/123456/vendor2__resource/index.html"/>
</aura:component>
```

Instead, use the `$Resource` global value provider to build the resource URL for the `<lightning:container>` component.

```
<aura:component>
  <lightning:container
    src="{!$Resource.vendor2__resource + '/index.html' }"/>
</aura:component>
```

Distribution Requirements

To upload a package to AppExchange, you must supply all the Lightning container component's original sources and dependencies. When you provide minified or transpiled code, you must also include the source files for that code and the source map (`.js.map`) files for the minified code.

The Lightning Realty App

The Lightning Realty App is a more robust example of messaging between the Lightning Container Component and Salesforce.

The Lightning Realty app's messaging framework relies on code in an Aura component, the component's handler, and the static resource referenced by `lightning:container`. The Lightning container component points to the message handling function in the Aura component's JavaScript controller. The message handling function takes in a message sent by the source JavaScript, which uses a method provided by the `lightning-container` NPM module.

See [Install the Example Lightning Realty App](#) for instructions to install this example in your development org.

Let's look at the Aura component first. Although the code that defines the Realty component is simple, it allows the JavaScript of the Realty app to communicate with Salesforce and load sample data.

```
<aura:component access="global" implements="flexipage:availableForAllPageTypes" >

  <aura:attribute access="global" name="mainTitle" type="String" required="true"
  default="My Properties"/>

  <aura:attribute access="private" name="messageReceived" type="String" default="" />
  <aura:attribute access="private" name="error" type="String" default="" />

  <div>
    <aura:if isTrue="={! !empty(v.messageReceived) }">
      <lightning:textarea name="messageReceivedTextArea" value=" {!v.messageReceived} "
      label=" "/>
    </aura:if>

    <aura:if isTrue="={! !empty(v.error) }">
      <lightning:textarea name="errorTextArea" value=" {!v.error}" label="Error: " />
    </aura:if>
  </div>
</aura:component>
```

```

        </aura:if>

        <lightning:container aura:id="ReactApp"
            src="{!$Resource.Realty + '/index.html?mainTitle=' +
v.mainTitle}"
            onmessage="{!!c.handleMessage}"
            onerror="{!!c.handleError}" />
    </div>

</aura:component>

```

This code is similar to the example code in [Sending Messages from the Lightning Container Component](#) and [Handling Errors in Your Container](#).

There's also code in the Aura component's controller and in the source JavaScript that allows the iframed app to communicate with Salesforce. In `PropertyHome.js`, part of the source, the realty app calls `LCC.sendMessage`. This segment of code filters the list of properties, then creates a message to send back to the container that includes the selected property's address, price, city, state, zip code, and description.

```

saveHandler(property) {
    let filteredProperty = propertyService.filterProperty(property);
    propertyService.createItem(filteredProperty).then(() => {
        propertyService.findAll(this.state.sort).then(properties => {
            let filteredProperties = propertyService.filterFoundProperties(properties);
            this.setState({addingProperty: false, properties:filteredProperties});
        });
        let message = {};
        message.address = property.address;
        message.price = property.price;
        message.city = property.city;
        message.state = property.state;
        message.zip = property.zip;
        message.description = property.description;
        LCC.sendMessage({name: "PropertyCreated", value: message});
    });
},

```

Then, the JavaScript calls `LCC.sendMessage` with a name-value pair. This code uses the `sendMessage` method, which is part of the messaging API provided by the `lightning-container` NPM module. For more information, see [Sending Messages to the Lightning Container Component](#).

The last bit of action happens in the component's controller, in the `handleMessage()` function.

```

handleMessage: function(component, message, helper) {
    var payload = message.getParams().payload;
    var name = payload.name;
    if (name === "PropertyCreated") {
        var value = payload.value;
        var messageToUser;
        if (value.price > 1000000) {
            messageToUser = "Big Real Estate Opportunity in " + value.city + ", " +
value.state + " : $" + value.price;
        }
        else {
            messageToUser = "Small Real Estate Opportunity in " + value.city + ", " +
value.state + " : $" + value.price;
        }
    }
}

```

```
        }
        var log = component.get("v.log");
        log.push(messageToUser);
        component.set("v.log", log);
    },
},
```

This function takes a message as an argument, and checks that the name is "PropertyCreated". This is the same `name` set by `LCC.sendMessage` in the app's JavaScript.

This function takes the message payload—in this case, a JSON array describing a property—and checks the value of the property. If the value is over \$1 million, it sends a message to the user telling him or her that there's a big real estate opportunity. Otherwise, it returns a message telling the user that there's a smaller real estate opportunity.

IN THIS SECTION:

[Install the Example Lightning Realty App](#)

See further examples of `lightning:container` in the Developerforce Git repository.

Install the Example Lightning Realty App

See further examples of `lightning:container` in the Developerforce Git repository.

Implement a more in-depth example of `lightning:container` with the code included in <https://github.com/developerforce/LightningContainerExamples>. This example uses React and `lightning:container` to show a real estate listing app in a Lightning page.

To implement this example, use npm. The easiest way to install npm is by installing `node.js`. Once you've installed npm, install the latest version by running `npm install --save latest-version` from the command line.

To create custom Lightning components, you also need to have enabled My Domain in your org. For more information on My Domain, see [My Domain](#) in the Salesforce Help.

1. Clone the Git repository. From the command line, enter `git clone`

<https://github.com/developerforce/LightningContainerExamples>

2. From the command line, navigate to `LightningContainerExamples/ReactJS/Javascript/Realty` and build the project's dependencies by entering `npm install`.

3. From the command line, build the app by entering `npm run build`.

4. Edit `package.json` and add your Salesforce login credentials where indicated.

5. From the command line, enter `npm run deploy`.

6. Log in to Salesforce and activate the new Realty Lightning page in the Lightning App Builder by adding it to a Lightning app.

7. To upload sample data to your org, enter `npm run load` from the command line.

See the Lightning realty app in action in your org. The app uses `lightning:container` to embed a React app in a Lightning page, displaying sample real estate listing data.

The screenshot shows a Salesforce Lightning component titled "Properties" under the "Realty" tab. The page displays a table of "My Properties" with 10 entries, sorted by address. The columns are ADDRESS, CITY, BEDROOMS, BATHROOMS, and PRICE. Each row includes a dropdown menu icon.

| ADDRESS | CITY | BEDROOMS | BATHROOMS | PRICE |
|-------------------|-----------|----------|-----------|----------------|
| 110 Baxter street | Boston | 3 | 2 | \$850,000.00 |
| 121 Harborwalk | Boston | 3 | 3 | \$450,000.00 |
| 127 Endicott st | Boston | 3 | 1 | \$450,000.00 |
| 18 Henry st | Cambridge | 4 | 3 | \$975,000.00 |
| 24 Pearl st | Cambridge | 5 | 4 | \$1,200,000.00 |
| 32 Prince st | Cambridge | 5 | 4 | \$930,000.00 |
| 448 Hanover st | Boston | 4 | 2 | \$725,000.00 |

The component and handler code are similar to the examples in [Sending Messages from the Lightning Container Component](#) and [Handling Errors in Your Container](#).

lightning-container NPM Module Reference

Use methods included in the lightning-container NPM module in your JavaScript code to send and receive messages to and from your custom Aura component, and to interact with the Salesforce REST API.

IN THIS SECTION:

[addMessageErrorHandler\(\)](#)

Mounts an error handling function, to be called when the messaging framework encounters an error.

[addMessageHandler\(\)](#)

Mounts a message handling function, used to handle messages sent from the Aura component to the framed JavaScript app.

[callApex\(\)](#)

Makes an Apex call.

[getRESTAPISessionKey\(\)](#)

Returns the Salesforce REST API session key.

[removeMessageErrorHandler\(\)](#)

Unmounts the error handling function.

[removeMessageHandler\(\)](#)

Unmounts the message-handling function.

sendMessage()

Sends a message from the framed JavaScript code to the Aura component.

addMessageErrorHandler()

Mounts an error handling function, to be called when the messaging framework encounters an error.

Sample

Used within a JavaScript app uploaded as a static resource and referenced by `lightning:container`, this example mounts a message error handling function. In a React app, functions must be mounted to be part of the document-object model and rendered in the output.

```
componentDidMount() {
    LCC.addMessageErrorHandler(this.onMessageError);
}
```

You can view and download this example in the [Developerforce Github Repository](#).

Arguments

| Name | Type | Description |
|--|----------|--|
| <code>handler: (errorMsg: string) => void)</code> | function | The function that handles error messages encountered in the messaging framework. |

Response

None.

addMessageHandler()

Mounts a message handling function, used to handle messages sent from the Aura component to the framed JavaScript app.

Sample

Used within a JavaScript app uploaded as a static resource and referenced by `lightning:container`, this example mounts a message handling function. In a React app, functions must be mounted to be part of the document-object model and rendered in the output.

```
componentDidMount() {
    LCC.addMessageHandler(this.onMessage);
}

onMessage(msg) {
    let name = msg.name;
    if (name === "General") {
        let value = msg.value;
        this.setState({messageReceived: value});
    }
}
```

```

else if (name === "Foo") {
    // A different response
}
}

```

You can view and download this example in the [Developerforce Github Repository](#).

Arguments

| Name | Type | Description |
|---|------|--|
| handler: (userMsg: any) function => void | | The function that handles messages sent from the Aura component. |

Response

None.

callApex()

Makes an Apex call.

Sample

Used within a JavaScript app uploaded as a static resource and referenced by `lightning:container`, this example calls the Apex method `getAccount`.

```

callApex() {
    LCC.callApex("lcc1.ApexController.getAccount",
        this.state.name,
        this.handleAccountQueryResponse,
        {escape: true});
}

```

You can view and download this example in the [Developerforce Github Repository](#).

Arguments

| Name | Type | Description |
|------------------------------|----------|--|
| fullyQualifiedApexMethodName | string | The name of the Apex method. |
| apexMethodParameters | array | A JSON array of arguments for the Apex method. |
| callbackFunction | function | A callback function. |
| apexCallConfiguration | array | Configuration parameters for the Apex call. |

Response

None.

getRESTAPISessionKey()

Returns the Salesforce REST API session key.

Use this method when your embedded app needs to interact with the Salesforce REST API, such as executing a SOQL query.

Don't use the session key to manage custom objects or fields. You can use the session key to create and update object records. Apps that use `lightning:container` should work with data, not metadata.

! **Important:** It's important to keep your API key secure. Don't give this key to code you don't trust, and don't include it in URLs or hyperlinks, even to another page in your app.

Salesforce uses the no-referrer policy to protect against leaking your app's URL to outside servers, such as image hosts. However, this policy doesn't protect some browsers, meaning your app's URLs could be included in outside requests.

Sample

Used within a JavaScript app uploaded as a static resource and referenced by `lightning:container`, this example gets the REST API session key and uses it to execute a SOQL query.

```
componentDidMount() {
  let sid = LCC.getRESTAPISessionKey();
  let conn = new JSForce.Connection({accessToken: sid});
  conn.query("SELECT Id, Name from Account LIMIT 50", this.handleAccountQueryResponse);
}
```

You can view and download this example in the [Developerforce Github Repository](#).

Arguments

None.

Response

| Name | Type | Description |
|------|--------|---------------------------|
| key | string | The REST API session key. |

removeMessageErrorHandler()

Unmounts the error handling function.

When using React, it's necessary to unmount functions to remove them from the DOM and perform necessary cleanup.

Sample

Used within a JavaScript app uploaded as a static resource and referenced by `lightning:container`, this example unmounts a message error handling function. In a React app, functions must be mounted to be part of the document-object model and rendered in the output.

```
componentWillUnmount() {
  LCC.removeMessageErrorHandler(this.onMessageError);
}
```

You can view and download this example in the [Developerforce Github Repository](#).

Arguments

| Name | Type | Description |
|-------------------------------------|----------|--|
| handler: (errorMsg: string) => void | function | The function that handles error messages encountered in the messaging framework. |

Response

None.

removeMessageHandler ()

Unmounts the message-handling function.

When using React, it's necessary to unmount functions to remove them from the DOM and perform necessary cleanup.

Sample

Used within a JavaScript app uploaded as a static resource and referenced by `lightning:container`, this example unmounts a message handling function.

```
componentWillUnmount() {
  LCC.removeMessageHandler(this.onMessage);
}
```

You can view and download this example in the [Developerforce Github Repository](#).

Arguments

| Name | Type | Description |
|---------------------------------|----------|--|
| handler: (userMsg: any) => void | function | The function that handles messages sent from the Aura component. |

Response

None.

sendMessage ()

Sends a message from the framed JavaScript code to the Aura component.

Sample

Used within a JavaScript app uploaded as a static resource and referenced by `lightning:container`, this example sends a message from the app to `lightning:container`.

```
sendMessage() {  
    LCC.sendMessage({name: "General", value: this.state.messageToSend});  
}
```

You can view and download this example in the [Developerforce Github Repository](#).

Arguments

| Name | Type | Description |
|---------|------|---|
| userMsg | any | While the data sent in the message is entirely under your control, by convention it's an object with name and value fields. |

Response

None.

CHAPTER 5 Communicating with Events

In this chapter ...

- Actions and Events
- Handling Events with Client-Side Controllers
- Component Events
- Application Events
- Event Handling Lifecycle
- Advanced Events Example
- Firing Lightning Events from Non-Lightning Code
- Events Best Practices
- Events Fired During the Rendering Lifecycle
- Events Handled in the Salesforce Mobile App and Lightning Experience
- System Events

The framework uses event-driven programming. You write handlers that respond to interface events as they occur. The events may or may not have been triggered by user interaction.

In the Aura Components programming model, events are fired from JavaScript controller actions. Events can contain attributes that can be set before the event is fired and read when the event is handled.

Events are declared by the `aura: event` tag in a `.evt` resource, and they can have one of two types: component or application.

Component Events

A component event is fired from an instance of a component. A component event can be handled by the component that fired the event or by a component in the containment hierarchy that receives the event.

Application Events

Application events follow a traditional publish-subscribe model. An application event is fired from an instance of a component. All components that provide a handler for the event are notified.

 **Note:** Always try to use a component event instead of an application event, if possible. Component events can only be handled by components above them in the containment hierarchy so their usage is more localized to the components that need to know about them. Application events are best used for something that should be handled at the application level, such as navigating to a specific record. Application events allow communication between components that are in separate parts of the application and have no direct containment relationship.

Actions and Events

The framework uses events to communicate data between components. Events are usually triggered by a user action.

Actions

User interaction with an element on a component or app. User actions trigger events, but events aren't always explicitly triggered by user actions. This type of action is *not* the same as a client-side JavaScript controller, which is sometimes known as a *controller action*. The following button is wired up to a browser `onclick` event in response to a button click.

```
<lightning:button label = "Click Me" onclick = "{!c.handleClick}" />
```

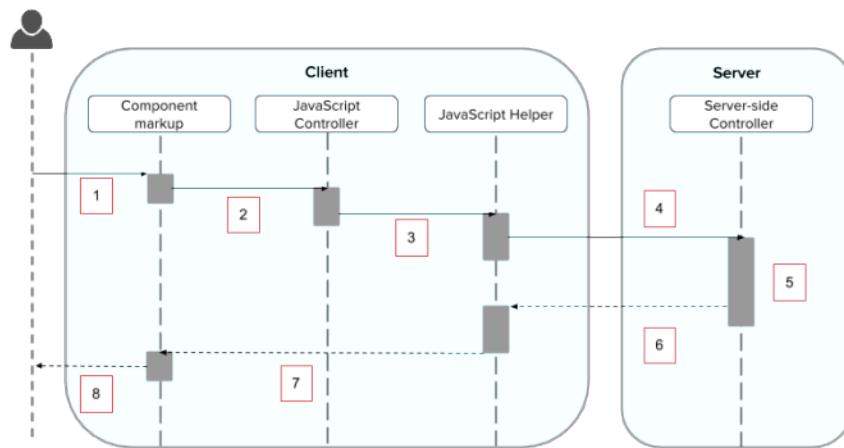
Clicking the button invokes the `handleClick` method in the component's client-side controller.

Events

A notification by the browser regarding an action. Browser events are handled by client-side JavaScript controllers, as shown in the previous example. A browser event is not the same as a framework *component event* or *application event*, which you can create and fire in a JavaScript controller to communicate data between components. For example, you can wire up the click event of a checkbox to a client-side controller, which fires a component event to communicate relevant data to a parent component.

Another type of event, known as a *system event*, is fired automatically by the framework during its lifecycle, such as during component initialization, change of an attribute value, and rendering. Components can handle a system event by registering the event in the component markup.

The following diagram describes what happens when a user clicks a button that requires the component to retrieve data from the server.



1. User clicks a button or interacts with a component, triggering a browser event. For example, you want to save data from the server when the button is clicked.
2. The button click invokes a client-side JavaScript controller, which provides some custom logic before invoking a helper function.
3. The JavaScript controller invokes a helper function. A helper function improves code reuse but it's optional for this example.
4. The helper function calls an Apex controller method and queues the action.
5. The Apex method is invoked and data is returned.
6. A JavaScript callback function is invoked when the Apex method completes.
7. The JavaScript callback function evaluates logic and updates the component's UI.

8. User sees the updated component.

SEE ALSO:

[Handling Events with Client-Side Controllers](#)
[Detecting Data Changes with Change Handlers](#)
[Calling a Server-Side Action](#)
[Events Fired During the Rendering Lifecycle](#)

Handling Events with Client-Side Controllers

A client-side controller handles events within a component. It's a JavaScript resource that defines the functions for all of the component's actions.

A client-side controller is a JavaScript object in object-literal notation containing a map of name-value pairs. Each name corresponds to a client-side action. Its value is the function code associated with the action. Client-side controllers are surrounded by parentheses and curly braces. Separate action handlers with commas (as you would with any JavaScript map).

```
({  
    myAction : function(cmp, event, helper) {  
        // add code for the action  
    },  
  
    anotherAction : function(cmp, event, helper) {  
        // add code for the action  
    }  
})
```

Each action function takes in three parameters:

1. `cmp`—The component to which the controller belongs.
2. `event`—The event that the action is handling.
3. `helper`—The component's helper, which is optional. A helper contains functions that can be reused by any JavaScript code in the component bundle.

Creating a Client-Side Controller

A client-side controller is part of the component bundle. It is auto-wired via the naming convention, `componentNameController.js`.

To create a client-side controller using the Developer Console, click **CONTROLLER** in the sidebar of the component.

Calling Client-Side Controller Actions

The following example component creates two buttons to contrast an HTML button with `<lightning:button>`, which is a standard Lightning component. Clicking on these buttons updates the `text` component attribute with the specified values. `target.get("v.label")` refers to the `label` attribute value on the button.

Component source

```
<aura:component>
    <aura:attribute name="text" type="String" default="Just a string. Waiting for change."/>

    <input type="button" value="Flawed HTML Button"
        onclick="alert('this will not work')"/>
    <br/>
    <lightning:button label="Framework Button" onclick="{!!c.handleClick}" />
    <br/>
    {!v.text}
</aura:component>
```

If you know some JavaScript, you might be tempted to write something like the first "Flawed" button because you know that HTML tags are first-class citizens in the framework. However, the "Flawed" button won't work because arbitrary JavaScript, such as the `alert()` call, in the component is ignored.

The framework has its own event system. DOM events are mapped to Lightning events, since HTML tags are mapped to Lightning components.

Any browser DOM element event starting with `on`, such as `onclick` or `onkeypress`, can be wired to a controller action. You can only wire browser events to controller actions.

The "Framework" button wires the `onclick` attribute in the `<lightning:button>` component to the `handleClick` action in the controller.

Client-side controller source

```
{
    handleClick : function(cmp, event) {
        var attributeValue = cmp.get("v.text");
        console.log("current text: " + attributeValue);

        var target = event.getSource();
        cmp.set("v.text", target.get("v.label"));
    }
}
```

The `handleClick` action uses `event.getSource()` to get the source component that fired this component event. In this case, the source component is the `<lightning:button>` in the markup.

The code then sets the value of the `text` component attribute to the value of the button's `label` attribute. The `text` component attribute is defined in the `<aura:attribute>` tag in the markup.



Tip: Use unique names for client-side and server-side actions in a component. A JavaScript function (client-side action) with the same name as an Apex method (server-side action) can lead to hard-to-debug issues. In debug mode, the framework logs a browser console warning about the clashing client-side and server-side action names.

Handling Framework Events

Handle framework events using actions in client-side component controllers. Framework events for common mouse and keyboard interactions are available with out-of-the-box components.

Accessing Component Attributes

In the `handleClick` function, notice that the first argument to every action is the component to which the controller belongs. One of the most common things you'll want to do with this component is look at and change its attribute values.

`cmp.get("v.attributeName")` returns the value of the `attributeName` attribute.

`cmp.set("v.attributeName", "attribute value")` sets the value of the `attributeName` attribute.

Invoking Another Action in the Controller

To call an action method from another method, put the common code in a helper function and invoke it using `helper.someFunction(cmp)`.

SEE ALSO:

[Sharing JavaScript Code in a Component Bundle](#)

[Event Handling Lifecycle](#)

[Creating Server-Side Logic with Controllers](#)

Component Events

A component event is fired from an instance of a component. A component event can be handled by the component that fired the event or by a component in the containment hierarchy that receives the event.

IN THIS SECTION:

[Component Event Propagation](#)

The framework supports *capture* and *bubble* phases for the propagation of component events. These phases are similar to DOM handling patterns and provide an opportunity for interested components to interact with an event and potentially control the behavior for subsequent handlers.

[Create Custom Component Events](#)

Create a custom component event using the `<aura:event>` tag in a `.evt` resource. Events can contain attributes that can be set before the event is fired and read when the event is handled.

[Fire Component Events](#)

Fire a component event to communicate data to another component. A component event can be handled by the component that fired the event or by a component in the containment hierarchy that receives the event.

Handling Component Events

A component event can be handled by the component that fired the event or by a component in the containment hierarchy that receives the event.

SEE ALSO:

[aura:method](#)

[Application Events](#)

[Handling Events with Client-Side Controllers](#)

[Advanced Events Example](#)

[What is Inherited?](#)

Component Event Propagation

The framework supports *capture* and *bubble* phases for the propagation of component events. These phases are similar to DOM handling patterns and provide an opportunity for interested components to interact with an event and potentially control the behavior for subsequent handlers.

The component that fires an event is known as the source component. The framework allows you to handle the event in different phases. These phases give you flexibility for how to best process the event for your application.

The phases are:

Capture

The event is captured and trickles down from the application root to the source component. The event can be handled by a component in the containment hierarchy that receives the captured event.

Event handlers are invoked in order from the application root down to the source component that fired the event.

Any registered handler in this phase can stop the event from propagating, at which point no more handlers are called in this phase or the bubble phase.

Bubble

The component that fired the event can handle it. The event then bubbles up from the source component to the application root. The event can be handled by a component in the containment hierarchy that receives the bubbled event.

Event handlers are invoked in order from the source component that fired the event up to the application root.

Any registered handler in this phase can stop the event from propagating, at which point no more handlers are called in this phase.

Here's the sequence of component event propagation.

1. **Event fired**—A component event is fired.
2. **Capture phase**—The framework executes the capture phase from the application root to the source component until all components are traversed. Any handling event can stop propagation by calling `stopPropagation()` on the event.
3. **Bubble phase**—The framework executes the bubble phase from the source component to the application root until all components are traversed or `stopPropagation()` is called.

 **Note:** Application events have a separate default phase. There's no separate default phase for component events. The default phase is the bubble phase.

Create Custom Component Events

Create a custom component event using the `<aura:event>` tag in a `.evt` resource. Events can contain attributes that can be set before the event is fired and read when the event is handled.

Use `type="COMPONENT"` in the `<aura:event>` tag for a component event. For example, this `c:compEvent` component event has one attribute with a name of `message`.

```
<!--c:compEvent-->
<aura:event type="COMPONENT">
    <!-- Add aura:attribute tags to define event shape.
        One sample attribute here. -->
    <aura:attribute name="message" type="String"/>
</aura:event>
```

The component that fires an event can set the event's data. To set the attribute values, call `event.setParam()` or `event.setParams()`. A parameter name set in the event must match the name attribute of an `<aura:attribute>` in the event. For example, if you fire `c:compEvent`, you could use:

```
event.setParam("message", "event message here");
```

The component that handles an event can retrieve the event data. To retrieve the attribute value in this event, call `event.getParam("message")` in the handler's client-side controller.

Fire Component Events

Fire a component event to communicate data to another component. A component event can be handled by the component that fired the event or by a component in the containment hierarchy that receives the event.

Register an Event

A component registers that it may fire an event by using `<aura:registerEvent>` in its markup. For example:

```
<aura:registerEvent name="sampleComponentEvent" type="c:compEvent"/>
```

We'll see how the value of the `name` attribute is used for firing and handling events.

Fire an Event

To get a reference to a component event in JavaScript, use `cmp.getEvent("evtName")` where `evtName` matches the `name` attribute in `<aura:registerEvent>`.

Use `fire()` to fire the event from an instance of a component. For example, in an action function in a client-side controller:

```
var compEvent = cmp.getEvent("sampleComponentEvent");
// Optional: set some data for the event (also known as event shape)
// A parameter's name must match the name attribute
// of one of the event's <aura:attribute> tags
// compEvent.setParams({ "myParam" : myValue });
compEvent.fire();
```

SEE ALSO:

[Fire Application Events](#)

Handling Component Events

A component event can be handled by the component that fired the event or by a component in the containment hierarchy that receives the event.

Use `<aura:handler>` in the markup of the handler component. For example:

```
<aura:handler name="sampleComponentEvent" event="c:compEvent"
  action="{!c.handleComponentEvent}" />
```

The `name` attribute in `<aura:handler>` must match the `name` attribute in the `<aura:registerEvent>` tag in the component that fires the event.

The `action` attribute of `<aura:handler>` sets the client-side controller action to handle the event.

The `event` attribute specifies the event being handled. The format is `namespace: eventName`.

In this example, when the event is fired, the `handleComponentEvent` client-side controller action is called.

Event Handling Phases

Component event handlers are associated with the bubble phase by default. To add a handler for the capture phase instead, use the `phase` attribute.

```
<aura:handler name="sampleComponentEvent" event="ns:eventName"
  action="{!c.handleComponentEvent}" phase="capture" />
```

Get the Source of an Event

In the client-side controller action for an `<aura:handler>` tag, use `evt.getSource()` to find out which component fired the event, where `evt` is a reference to the event. To retrieve the source element, use `evt.getSource().getElement()`.

IN THIS SECTION:

[Component Handling Its Own Event](#)

A component can handle its own event by using the `<aura:handler>` tag in its markup.

[Handle Component Event of Instantiated Component](#)

A parent component can set a handler action when it instantiates a child component in its markup.

[Handling Bubbled or Captured Component Events](#)

Event propagation rules determine which components in the containment hierarchy can handle events by default in the bubble or capture phases. Learn about the rules and how to handle events in the bubble or capture phases.

[Handling Component Events Dynamically](#)

A component can have its handler bound dynamically via JavaScript. This is useful if a component is created in JavaScript on the client-side.

SEE ALSO:

[Component Event Propagation](#)

[Handling Application Events](#)

Component Handling Its Own Event

A component can handle its own event by using the `<aura:handler>` tag in its markup.

The `action` attribute of `<aura:handler>` sets the client-side controller action to handle the event. For example:

```
<aura:registerEvent name="sampleComponentEvent" type="c:compEvent"/>
<aura:handler name="sampleComponentEvent" event="c:compEvent"
    action="{!c.handleSampleEvent}" />
```

 **Note:** The name attributes in `<aura:registerEvent>` and `<aura:handler>` must match, since each event is defined by its name.

SEE ALSO:

[Handle Component Event of Instantiated Component](#)

Handle Component Event of Instantiated Component

A parent component can set a handler action when it instantiates a child component in its markup.

Let's look at an example. `c:child` registers that it may fire a `sampleComponentEvent` event by using `<aura:registerEvent>` in its markup.

```
<!-- c:child -->
<aura:component>
    <aura:registerEvent name="sampleComponentEvent" type="c:compEvent"/>
</aura:component>
```

`c:parent` sets a handler for this event when it instantiates `c:child` in its markup.

```
<!-- parent.cmp -->
<aura:component>
    <c:child sampleComponentEvent="{!c.handleChildEvent}" />
</aura:component>
```

Note how `c:parent` uses the following syntax to set a handler for the `sampleComponentEvent` event fired by `c:child`.

```
<c:child sampleComponentEvent="{!c.handleChildEvent}" />
```

The syntax looks similar to how you set an attribute called `sampleComponentEvent`. However, in this case, `sampleComponentEvent` isn't an attribute. `sampleComponentEvent` matches the event name declared in `c:child`.

```
<aura:registerEvent name="sampleComponentEvent" type="c:compEvent"/>
```

The preceding syntax is a convenient shortcut for the normal way that a component declares a handler for an event. The parent component can only use this syntax to handle events from a direct descendent. If you want to be more explicit in `c:parent` that you're handling an event, or if the event might be fired by a component further down the component hierarchy, use an `<aura:handler>` tag instead of declaring the handler within the `<c:child>` tag.

```
<!-- parent.cmp -->
<aura:component>
    <aura:handler name="sampleComponentEvent" event="c:compEvent"
        action="{!c.handleSampleEvent}" />
    <c:child />
</aura:component>
```

The two versions of `c:parent` markup behave the same. However, using `<aura:handler>` makes it more obvious that you're handling a `sampleComponentEvent` event.

SEE ALSO:

[Component Handling Its Own Event](#)

[Handling Bubbled or Captured Component Events](#)

Handling Bubbled or Captured Component Events

Event propagation rules determine which components in the containment hierarchy can handle events by default in the bubble or capture phases. Learn about the rules and how to handle events in the bubble or capture phases.

The framework supports *capture* and *bubble* phases for the propagation of component events. These phases are similar to DOM handling patterns and provide an opportunity for interested components to interact with an event and potentially control the behavior for subsequent handlers. The capture phase executes before the bubble phase.

Default Event Propagation Rules

By default, every parent in the containment hierarchy can't handle an event during the capture and bubble phases. Instead, the event propagates to every owner in the containment hierarchy.

A component's owner is the component that is responsible for its creation. For declaratively created components, the owner is the outermost component containing the markup that references the component firing the event. For programmatically created components, the owner component is the component that invoked `$A.createComponent` to create it.

The same rules apply for the capture phase, although the direction of event propagation (down) is the opposite of the bubble phase (up).

Confused? It makes more sense when you look at an example in the bubbling phase.

`c:owner` contains `c:container`, which in turn contains `c:eventSource`.

```
<!--c:owner-->
<aura:component>
  <c:container>
    <c:eventSource />
  </c:container>
</aura:component>
```

If `c:eventSource` fires an event, it can handle the event itself. The event then bubbles up the containment hierarchy.

`c:container` contains `c:eventSource` but it's not the owner because it's not the outermost component in the markup, so it can't handle the bubbled event.

`c:owner` is the owner because `c:container` is in its markup. `c:owner` can handle the event.

Propagation to All Container Components

The default behavior doesn't allow an event to be handled by every parent in the containment hierarchy. Some components contain other components but aren't the owner of those components. These components are known as container components. In the example, `c:container` is a container component because it's not the owner for `c:eventSource`. By default, `c:container` can't handle events fired by `c:eventSource`.

A container component has a facet attribute whose type is `Aura.Component []`, such as the default `body` attribute. The container component includes those components in its definition using an expression, such as `{ !v.body }`. The container component isn't the owner of the components rendered with that expression.

To allow a container component to handle the event, add `includeFacets="true"` to the `<aura:handler>` tag of the container component. For example, adding `includeFacets="true"` to the handler in the container component, `c:container`, enables it to handle the component event bubbled from `c:eventSource`.

```
<aura:handler name="bubblingEvent" event="c:compEvent" action="{!!c.handleBubbling}" includeFacets="true" />
```

Handle Bubbled Event

A component that fires a component event registers that it fires the event by using the `<aura:registerEvent>` tag.

```
<aura:component>
  <aura:registerEvent name="compEvent" type="c:compEvent" />
</aura:component>
```

A component handling the event in the bubble phase uses the `<aura:handler>` tag to assign a handling action in its client-side controller.

```
<aura:component>
  <aura:handler name="compEvent" event="c:compEvent" action="{!!c.handleBubbling}" />
</aura:component>
```

 **Note:** The name attribute in `<aura:handler>` must match the name attribute in the `<aura:registerEvent>` tag in the component that fires the event.

Handle Captured Event

A component handling the event in the capture phase uses the `<aura:handler>` tag to assign a handling action in its client-side controller.

```
<aura:component>
  <aura:handler name="compEvent" event="c:compEvent" action="{!!c.handleCapture}" phase="capture" />
</aura:component>
```

The default handling phase for component events is bubble if no `phase` attribute is set.

Stop Event Propagation

Use the `stopPropagation()` method in the `Event` object to stop the event propagating to other components.

Pausing Event Propagation for Asynchronous Code Execution

Use `event.pause()` to pause event handling and propagation until `event.resume()` is called. This flow-control mechanism is useful for any decision that depends on the response from the execution of asynchronous code. For example, you might make a decision about event propagation based on the response from an asynchronous call to native mobile code.

You can call `pause()` or `resume()` in the capture or bubble phases.

Event Bubbling Example

Let's look at an example so you can play around with it yourself.

```
<!--c:eventBubblingParent-->
<aura:component>
    <c:eventBubblingChild>
        <c:eventBubblingGrandchild />
    </c:eventBubblingChild>
</aura:component>
```

 **Note:** This sample code uses the default `c` namespace. If your org has a namespace, use that namespace instead.

First, we define a simple component event.

```
<!--c:compEvent-->
<aura:event type="COMPONENT">
    <!--simple event with no attributes-->
</aura:event>
```

`c:eventBubblingEmitter` is the component that fires `c:compEvent`.

```
<!--c:eventBubblingEmitter-->
<aura:component>
    <aura:registerEvent name="bubblingEvent" type="c:compEvent" />
    <lightning:button onclick="{!c.fireEvent}" label="Start Bubbling"/>
</aura:component>
```

Here's the controller for `c:eventBubblingEmitter`. When you press the button, it fires the `bubblingEvent` event registered in the markup.

```
/*eventBubblingEmitterController.js*/
{
    fireEvent : function(cmp) {
        var cmpEvent = cmp.getEvent("bubblingEvent");
        cmpEvent.fire();
    }
}
```

`c:eventBubblingGrandchild` contains `c:eventBubblingEmitter` and uses `<aura:handler>` to assign a handler for the event.

```
<!--c:eventBubblingGrandchild-->
<aura:component>
    <aura:handler name="bubblingEvent" event="c:compEvent" action="{!!c.handleBubbling}"/>

    <div class="grandchild">
        <c:eventBubblingEmitter />
    </div>
</aura:component>
```

Here's the controller for `c:eventBubblingGrandchild`.

```
/*eventBubblingGrandchildController.js*/
{
    handleBubbling : function(component, event) {
```

```

        console.log("Grandchild handler for " + event.getName());
    }
}

```

The controller logs the event name when the handler is called.

Here's the markup for `c:eventBubblingChild`. We will pass `c:eventBubblingGrandchild` in as the body of `c:eventBubblingChild` when we create `c:eventBubblingParent` later in this example.

```

<!--c:eventBubblingChild-->
<aura:component>
    <aura:handler name="bubblingEvent" event="c:compEvent" action="{!c.handleBubbling}" />

    <div class="child">
        {!v.body}
    </div>
</aura:component>

```

Here's the controller for `c:eventBubblingChild`.

```

/*eventBubblingChildController.js*/
{
    handleBubbling : function(component, event) {
        console.log("Child handler for " + event.getName());
    }
}

```

`c:eventBubblingParent` contains `c:eventBubblingChild`, which in turn contains `c:eventBubblingGrandchild`.

```

<!--c:eventBubblingParent-->
<aura:component>
    <aura:handler name="bubblingEvent" event="c:compEvent" action="{!c.handleBubbling}" />

    <div class="parent">
        <c:eventBubblingChild>
            <c:eventBubblingGrandchild />
        </c:eventBubblingChild>
    </div>
</aura:component>

```

Here's the controller for `c:eventBubblingParent`.

```

/*eventBubblingParentController.js*/
{
    handleBubbling : function(component, event) {
        console.log("Parent handler for " + event.getName());
    }
}

```

Now, let's see what happens when you run the code.

1. In your browser, navigate to `c:eventBubblingParent`. Create a `.app` resource that contains `<c:eventBubblingParent />`.
2. Click the **Start Bubbling** button that is part of the markup in `c:eventBubblingEmitter`.

3. Note the output in your browser's console:

```
Grandchild handler for bubblingEvent
Parent handler for bubblingEvent
```

The `c:compEvent` event is bubbled to `c:eventBubblingGrandchild` and `c:eventBubblingParent` as they are owners in the containment hierarchy. The event is not handled by `c:eventBubblingChild` as `c:eventBubblingChild` is in the markup for `c:eventBubblingParent` but it's not an owner as it's not the outermost component in that markup.

Now, let's see how to stop event propagation. Edit the controller for `c:eventBubblingGrandchild` to stop propagation.

```
/*eventBubblingGrandchildController.js*/
{
  handleBubbling : function(component, event) {
    console.log("Grandchild handler for " + event.getName());
    event.stopPropagation();
  }
}
```

Now, navigate to `c:eventBubblingParent` and click the **Start Bubbling** button.

Note the output in your browser's console:

```
Grandchild handler for bubblingEvent
```

The event no longer bubbles up to the `c:eventBubblingParent` component.

SEE ALSO:

[Component Event Propagation](#)

[Handle Component Event of Instantiated Component](#)

Handling Component Events Dynamically

A component can have its handler bound dynamically via JavaScript. This is useful if a component is created in JavaScript on the client-side.

For more information, see [Dynamically Adding Event Handlers To a Component](#) on page 372.

Component Event Example

Here's a simple use case of using a component event to update an attribute in another component.

1. A user clicks a button in the notifier component, `ceNotifier.cmp`.
2. The client-side controller for `ceNotifier.cmp` sets a message in a component event and fires the event.
3. The handler component, `ceHandler.cmp`, contains the notifier component, and handles the fired event.
4. The client-side controller for `ceHandler.cmp` sets an attribute in `ceHandler.cmp` based on the data sent in the event.

 **Note:** The event and components in this example use the default `c` namespace. If your org has a namespace, use that namespace instead.

Component Event

The `ceEvent.evt` component event has one attribute. We'll use this attribute to pass some data in the event when it's fired.

```
<!--c:ceEvent-->
<aura:event type="COMPONENT">
    <aura:attribute name="message" type="String"/>
</aura:event>
```

Notifier Component

The `c:ceNotifier` component uses `aura:registerEvent` to declare that it may fire the component event.

The button in the component contains an `onclick` browser event that is wired to the `fireComponentEvent` action in the client-side controller. The action is invoked when you click the button.

```
<!--c:ceNotifier-->
<aura:component>
    <aura:registerEvent name="cmpEvent" type="c:ceEvent"/>

    <h1>Simple Component Event Sample</h1>
    <p><lightning:button
        label="Click here to fire a component event"
        onclick=" {!c.fireComponentEvent} " />
    </p>
</aura:component>
```

The client-side controller gets an instance of the event by calling `cmp.getEvent("cmpEvent")`, where `cmpEvent` matches the value of the `name` attribute in the `<aura:registerEvent>` tag in the component markup. The controller sets the `message` attribute of the event and fires the event.

```
/* ceNotifierController.js */
{
    fireComponentEvent : function(cmp, event) {
        // Get the component event by using the
        // name value from aura:registerEvent
        var cmpEvent = cmp.getEvent("cmpEvent");
        cmpEvent.setParams({
            "message" : "A component event fired me. " +
            "It all happened so fast. Now, I'm here!" });
        cmpEvent.fire();
    }
}
```

Handler Component

The `c:ceHandler` handler component contains the `c:ceNotifier` component. The `<aura:handler>` tag uses the same value of the `name` attribute, `cmpEvent`, from the `<aura:registerEvent>` tag in `c:ceNotifier`. This wires up `c:ceHandler` to handle the event bubbled up from `c:ceNotifier`.

When the event is fired, the `handleComponentEvent` action in the client-side controller of the handler component is invoked.

```
<!--c:ceHandler-->
<aura:component>
    <aura:attribute name="messageFromEvent" type="String"/>
```

```

<aura:attribute name="numEvents" type="Integer" default="0"/>

<!-- Note that name="cmpEvent" in aura:registerEvent
    in ceNotifier.cmp -->
<aura:handler name="cmpEvent" event="c:ceEvent" action="{!c.handleComponentEvent}"/>

<!-- handler contains the notifier component -->
<c:ceNotifier />

<p>{!v.messageFromEvent}</p>
<p>Number of events: {!v.numEvents}</p>

</aura:component>

```

The controller retrieves the data sent in the event and uses it to update the `messageFromEvent` attribute in the handler component.

```

/* ceHandlerController.js */
{
    handleComponentEvent : function(cmp, event) {
        var message = event.getParam("message");

        // set the handler attributes based on event data
        cmp.set("v.messageFromEvent", message);
        var numEventsHandled = parseInt(cmp.get("v.numEvents")) + 1;
        cmp.set("v.numEvents", numEventsHandled);
    }
}

```

Put It All Together

Add the `c:ceHandler` component to a `c:ceHandlerApp` application. Navigate to the application and click the button to fire the component event.

<https://<myDomain>.lightning.force.com/c/ceHandlerApp.app>, where `<myDomain>` is the name of your custom Salesforce domain.

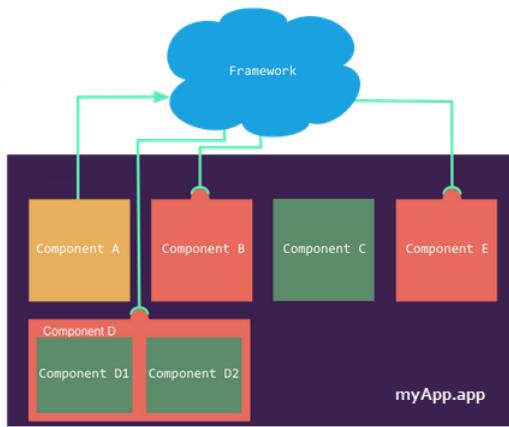
If you want to access data on the server, you could extend this example to call a server-side controller from the handler's client-side controller.

SEE ALSO:

- [Component Events](#)
- [Creating Server-Side Logic with Controllers](#)
- [Application Event Example](#)

Application Events

Application events follow a traditional publish-subscribe model. An application event is fired from an instance of a component. All components that provide a handler for the event are notified.



IN THIS SECTION:

[Application Event Propagation](#)

The framework supports *capture*, *bubble*, and *default* phases for the propagation of application events. The capture and bubble phases are similar to DOM handling patterns and provide an opportunity for interested components to interact with an event and potentially control the behavior for subsequent handlers. The default phase preserves the framework's original handling behavior.

[Create Custom Application Events](#)

Create a custom application event using the `<aura:event>` tag in a `.evt` resource. Events can contain attributes that can be set before the event is fired and read when the event is handled.

[Fire Application Events](#)

Application events follow a traditional publish-subscribe model. An application event is fired from an instance of a component. All components that provide a handler for the event are notified.

[Handling Application Events](#)

Use `<aura:handler>` in the markup of the handler component.

SEE ALSO:

[Component Events](#)

[Handling Events with Client-Side Controllers](#)

[Application Event Propagation](#)

[Advanced Events Example](#)

Application Event Propagation

The framework supports *capture*, *bubble*, and *default* phases for the propagation of application events. The capture and bubble phases are similar to DOM handling patterns and provide an opportunity for interested components to interact with an event and potentially control the behavior for subsequent handlers. The default phase preserves the framework's original handling behavior.

The component that fires an event is known as the source component. The framework allows you to handle the event in different phases. These phases give you flexibility for how to best process the event for your application.

The phases are:

Capture

The event is captured and trickles down from the application root to the source component. The event can be handled by a component in the containment hierarchy that receives the captured event.

Event handlers are invoked in order from the application root down to the source component that fired the event.

Any registered handler in this phase can stop the event from propagating, at which point no more handlers are called in this phase or the bubble phase. If a component stops the event propagation using `event.stopPropagation()`, the component becomes the root node used in the default phase.

Any registered handler in this phase can cancel the default behavior of the event by calling `event.preventDefault()`. This call prevents execution of any of the handlers in the default phase.

Bubble

The component that fired the event can handle it. The event then bubbles up from the source component to the application root. The event can be handled by a component in the containment hierarchy that receives the bubbled event.

Event handlers are invoked in order from the source component that fired the event up to the application root.

Any registered handler in this phase can stop the event from propagating, at which point no more handlers will be called in this phase. If a component stops the event propagation using `event.stopPropagation()`, the component becomes the root node used in the default phase.

Any registered handler in this phase can cancel the default behavior of the event by calling `event.preventDefault()`. This call prevents execution of any of the handlers in the default phase.

Default

Event handlers are invoked in a non-deterministic order from the root node through its subtree. The default phase doesn't have the same propagation rules related to component hierarchy as the capture and bubble phases. The default phase can be useful for handling application events that affect components in different sub-trees of your app.

If the event's propagation wasn't stopped in a previous phase, the root node defaults to the application root. If the event's propagation was stopped in a previous phase, the root node is set to the component whose handler invoked `event.stopPropagation()`.

Here is the sequence of application event propagation.

- 1. Event fired**—An application event is fired. The component that fires the event is known as the source component.
- 2. Capture phase**—The framework executes the capture phase from the application root to the source component until all components are traversed. Any handling event can stop propagation by calling `stopPropagation()` on the event.
- 3. Bubble phase**—The framework executes the bubble phase from the source component to the application root until all components are traversed or `stopPropagation()` is called.
- 4. Default phase**—The framework executes the default phase from the root node unless `preventDefault()` was called in the capture or bubble phases. If the event's propagation wasn't stopped in a previous phase, the root node defaults to the application root. If the event's propagation was stopped in a previous phase, the root node is set to the component whose handler invoked `event.stopPropagation()`.

Create Custom Application Events

Create a custom application event using the `<aura:event>` tag in a `.evt` resource. Events can contain attributes that can be set before the event is fired and read when the event is handled.

Use `type="APPLICATION"` in the `<aura:event>` tag for an application event. For example, this `c:appEvent` application event has one attribute with a name of `message`.

```
<!--c:appEvent-->
<aura:event type="APPLICATION">
```

```
<!-- Add aura:attribute tags to define event shape.
One sample attribute here. -->
<aura:attribute name="message" type="String"/>
</aura:event>
```

The component that fires an event can set the event's data. To set the attribute values, call `event.setParam()` or `event.setParams()`. A parameter name set in the event must match the `name` attribute of an `<aura:attribute>` in the event. For example, if you fire `c:appEvent`, you could use:

```
event.setParam("message", "event message here");
```

The component that handles an event can retrieve the event data. To retrieve the attribute in this event, call `event.getParam("message")` in the handler's client-side controller.

Fire Application Events

Application events follow a traditional publish-subscribe model. An application event is fired from an instance of a component. All components that provide a handler for the event are notified.

Register an Event

A component registers that it may fire an application event by using `<aura:registerEvent>` in its markup. The `name` attribute is required but not used for application events. The `name` attribute is only relevant for component events. This example uses `name="appEvent"` but the value isn't used anywhere.

```
<aura:registerEvent name="appEvent" type="c:appEvent"/>
```

Fire an Event

Use `$A.get("e.myNamespace:myAppEvent")` in JavaScript to get an instance of the `myAppEvent` event in the `myNamespace` namespace.

 **Note:** The syntax to get an instance of an application event is different than the syntax to get a component event, which is `cmp.getEvent("evtName")`.

Use `fire()` to fire the event.

```
var appEvent = $A.get("e.c:appEvent");
// Optional: set some data for the event (also known as event shape)
// A parameter's name must match the name attribute
// of one of the event's <aura:attribute> tags
//appEvent.setParams({ "myParam" : myValue });
appEvent.fire();
```

Events Fired on App Rendering

Some events are automatically fired when an app is rendering. For more information, see [Events Fired During the Rendering Lifecycle](#) on page 290.

SEE ALSO:

[Fire Component Events](#)

Handling Application Events

Use `<aura:handler>` in the markup of the handler component.

For example:

```
<aura:handler event="c:appEvent" action="{!c.handleApplicationEvent}" />
```

The `event` attribute specifies the event being handled. The format is **namespace: eventName**.

The `action` attribute of `<aura:handler>` sets the client-side controller action to handle the event.



Note: The handler for an application event won't work if you set the `name` attribute in `<aura:handler>`. Use the `name` attribute only when you're handling component events.

In this example, when the event is fired, the `handleApplicationEvent` client-side controller action is called.

Event Handling Phases

The framework allows you to handle the event in different phases. These phases give you flexibility for how to best process the event for your application.

Application event handlers are associated with the default phase. To add a handler for the capture or bubble phases instead, use the `phase` attribute.

Get the Source of an Event

In the client-side controller action for an `<aura:handler>` tag, use `evt.getSource()` to find out which component fired the event, where `evt` is a reference to the event. To retrieve the source element, use `evt.getSource().getElement()`.

IN THIS SECTION:

[Handling Bubbled or Captured Application Events](#)

Event propagation rules determine which components in the containment hierarchy can handle events by default in the bubble or capture phases. Learn about the rules and how to handle events in the bubble or capture phases.

SEE ALSO:

[Handling Component Events](#)

Handling Bubbled or Captured Application Events

Event propagation rules determine which components in the containment hierarchy can handle events by default in the bubble or capture phases. Learn about the rules and how to handle events in the bubble or capture phases.

The framework supports *capture*, *bubble*, and *default* phases for the propagation of application events. The capture and bubble phases are similar to DOM handling patterns and provide an opportunity for interested components to interact with an event and potentially control the behavior for subsequent handlers. The default phase preserves the framework's original handling behavior.

Default Event Propagation Rules

By default, every parent in the containment hierarchy can't handle an event during the capture and bubble phases. Instead, the event propagates to every owner in the containment hierarchy.

A component's owner is the component that is responsible for its creation. For declaratively created components, the owner is the outermost component containing the markup that references the component firing the event. For programmatically created components, the owner component is the component that invoked `$A.createComponent` to create it.

The same rules apply for the capture phase, although the direction of event propagation (down) is the opposite of the bubble phase (up).

Confused? It makes more sense when you look at an example in the bubbling phase.

`c:owner` contains `c:container`, which in turn contains `c:eventSource`.

```
<!--c:owner-->
<aura:component>
  <c:container>
    <c:eventSource />
  </c:container>
</aura:component>
```

If `c:eventSource` fires an event, it can handle the event itself. The event then bubbles up the containment hierarchy.

`c:container` contains `c:eventSource` but it's not the owner because it's not the outermost component in the markup, so it can't handle the bubbled event.

`c:owner` is the owner because `c:container` is in its markup. `c:owner` can handle the event.

Propagation to All Container Components

The default behavior doesn't allow an event to be handled by every parent in the containment hierarchy. Some components contain other components but aren't the owner of those components. These components are known as container components. In the example, `c:container` is a container component because it's not the owner for `c:eventSource`. By default, `c:container` can't handle events fired by `c:eventSource`.

A container component has a facet attribute whose type is `Aura.Component []`, such as the default `body` attribute. The container component includes those components in its definition using an expression, such as `{!v.body}`. The container component isn't the owner of the components rendered with that expression.

To allow a container component to handle the event, add `includeFacets="true"` to the `<aura:handler>` tag of the container component. For example, adding `includeFacets="true"` to the handler in the container component, `c:container`, enables it to handle the component event bubbled from `c:eventSource`.

```
<aura:handler name="bubblingEvent" event="c:compEvent" action="{!c.handleBubbling}"
  includeFacets="true" />
```

Handle Bubbled Event

To add a handler for the bubble phase, set `phase="bubble"`.

```
<aura:handler event="c:appEvent" action="{!c.handleBubbledEvent}"
  phase="bubble" />
```

The `event` attribute specifies the event being handled. The format is `namespace: eventName`.

The `action` attribute of `<aura:handler>` sets the client-side controller action to handle the event.

Handle Captured Event

To add a handler for the capture phase, set `phase="capture"`.

```
<aura:handler event="c:appEvent" action="{!c.handleCapturedEvent}"
    phase="capture" />
```

Stop Event Propagation

Use the `stopPropagation()` method in the `Event` object to stop the event propagating to other components.

Pausing Event Propagation for Asynchronous Code Execution

Use `event.pause()` to pause event handling and propagation until `event.resume()` is called. This flow-control mechanism is useful for any decision that depends on the response from the execution of asynchronous code. For example, you might make a decision about event propagation based on the response from an asynchronous call to native mobile code.

You can call `pause()` or `resume()` in the capture or bubble phases.

Application Event Example

Here's a simple use case of using an application event to update an attribute in another component.

1. A user clicks a button in the notifier component, `aeNotifier.cmp`.
2. The client-side controller for `aeNotifier.cmp` sets a message in a component event and fires the event.
3. The handler component, `aeHandler.cmp`, handles the fired event.
4. The client-side controller for `aeHandler.cmp` sets an attribute in `aeHandler.cmp` based on the data sent in the event.

 **Note:** The event and components in this example use the default `c` namespace. If your org has a namespace, use that namespace instead.

Application Event

The `aeEvent.evt` application event has one attribute. We'll use this attribute to pass some data in the event when it's fired.

```
<!--c:aeEvent-->
<aura:event type="APPLICATION">
    <aura:attribute name="message" type="String"/>
</aura:event>
```

Notifier Component

The `aeNotifier.cmp` notifier component uses `aura:registerEvent` to declare that it may fire the application event. The `name` attribute is required but not used for application events. The `name` attribute is only relevant for component events.

The button in the component contains a `onclick` browser event that is wired to the `fireApplicationEvent` action in the client-side controller. Clicking this button invokes the action.

```
<!--c:aeNotifier-->
<aura:component>
    <aura:registerEvent name="appEvent" type="c:aeEvent"/>
```

```
<h1>Simple Application Event Sample</h1>
<p><lightning:button
    label="Click here to fire an application event"
    onclick="{!!c.fireApplicationEvent}" />
</p>
</aura:component>
```

The client-side controller gets an instance of the event by calling `$A.get("e.c:aeEvent")`. The controller sets the `message` attribute of the event and fires the event.

```
/* aeNotifierController.js */
{
    fireApplicationEvent : function(cmp, event) {
        // Get the application event by using the
        // e.<namespace>.<event> syntax
        var appEvent = $A.get("e.c:aeEvent");
        appEvent.setParams({
            "message" : "An application event fired me. " +
            "It all happened so fast. Now, I'm everywhere!" });
        appEvent.fire();
    }
}
```

Handler Component

The `aeHandler.cmp` handler component uses the `<aura:handler>` tag to register that it handles the application event.

 **Note:** The handler for an application event won't work if you set the `name` attribute in `<aura:handler>`. Use the `name` attribute only when you're handling component events.

When the event is fired, the `handleApplicationEvent` action in the client-side controller of the handler component is invoked.

```
<!--c:aeHandler-->
<aura:component>
    <aura:attribute name="messageFromEvent" type="String"/>
    <aura:attribute name="numEvents" type="Integer" default="0"/>

    <aura:handler event="c:aeEvent" action="{!!c.handleApplicationEvent}" />

    <p>{!v.messageFromEvent}</p>
    <p>Number of events: {!v.numEvents}</p>
</aura:component>
```

The controller retrieves the data sent in the event and uses it to update the `messageFromEvent` attribute in the handler component.

```
/* aeHandlerController.js */
{
    handleApplicationEvent : function(cmp, event) {
        var message = event.getParam("message");

        // set the handler attributes based on event data
        cmp.set("v.messageFromEvent", message);
        var numEventsHandled = parseInt(cmp.get("v.numEvents")) + 1;
        cmp.set("v.numEvents", numEventsHandled);
```

```
    }  
}
```

Container Component

The `aeContainer.cmp` container component contains the notifier and handler components. This is different from the component event example where the handler contains the notifier component.

```
<!--c:aeContainer-->  
<aura:component>  
  <c:aeNotifier/>  
  <c:aeHandler/>  
</aura:component>
```

Put It All Together

You can test this code by adding `<c:aeContainer>` to a sample `aeWrapper.app` application and navigating to the application.

`https://<myDomain>.lightning.force.com/c/aeWrapper.app`, where `<myDomain>` is the name of your custom Salesforce domain.

If you want to access data on the server, you could extend this example to call a server-side controller from the handler's client-side controller.

SEE ALSO:

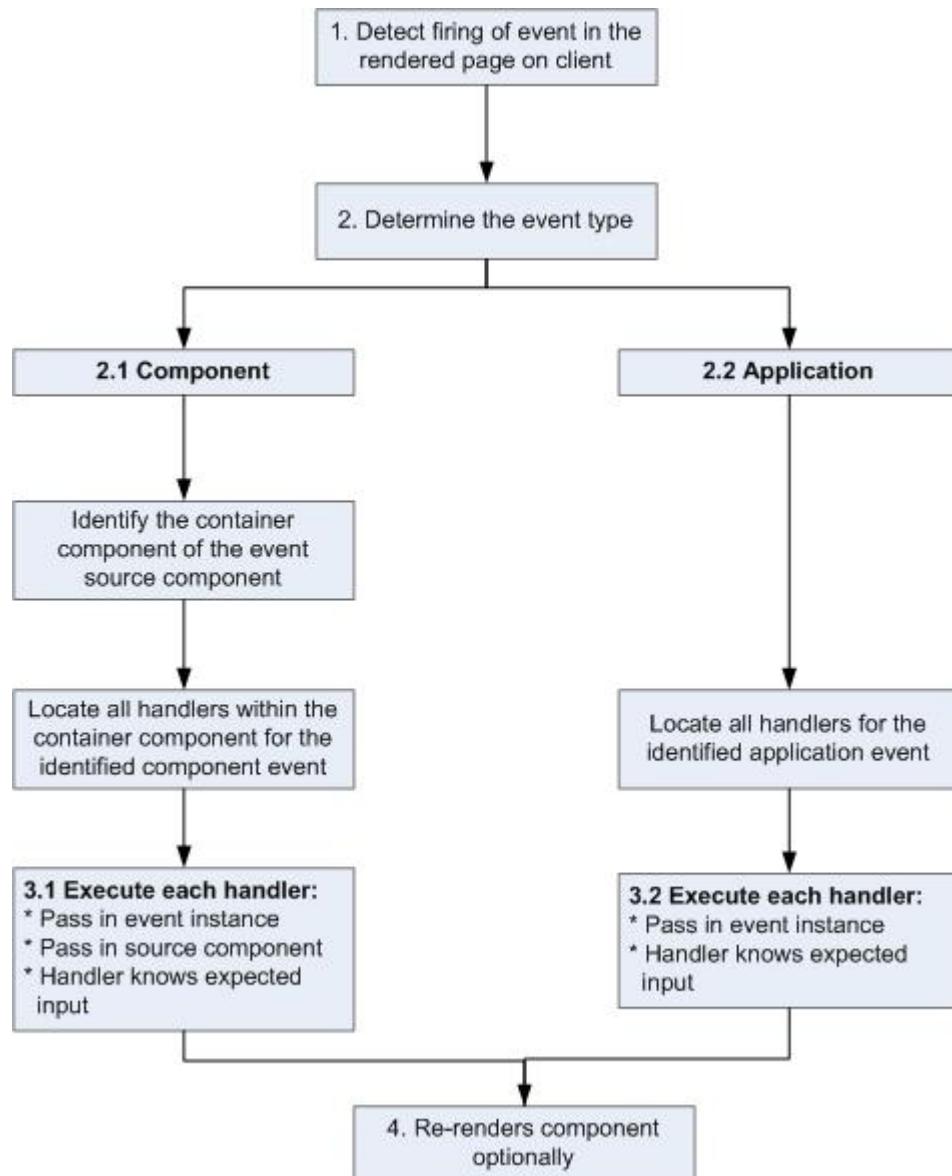
[Application Events](#)

[Creating Server-Side Logic with Controllers](#)

[Component Event Example](#)

Event Handling Lifecycle

The following chart summarizes how the framework handles events.



1 Detect Firing of Event

The framework detects the firing of an event. For example, the event could be triggered by a button click in a notifier component.

2 Determine the Event Type

2.1 Component Event

The parent or container component instance that fired the event is identified. This container component locates all relevant event handlers for further processing.

2.2 Application Event

Any component can have an event handler for this event. All relevant event handlers are located.

3 Execute each Handler

3.1 Executing a Component Event Handler

Each of the event handlers defined in the container component for the event are executed by the handler controller, which can also:

- Set attributes or modify data on the component (causing a re-rendering of the component).
- Fire another event or invoke a client-side or server-side action.

3.2 Executing an Application Event Handler

All event handlers are executed. When the event handler is executed, the event instance is passed into the event handler.

4 Re-render Component (optional)

After the event handlers and any callback actions are executed, a component might be automatically re-rendered if it was modified during the event handling process.

SEE ALSO:

[Create a Custom Renderer](#)

Advanced Events Example

This example builds on the simpler component and application event examples. It uses one notifier component and one handler component that work with both component and application events. Before we see a component wired up to events, let's look at the individual resources involved.

This table summarizes the roles of the various resources used in the example. The source code for these resources is included after the table.

| Resource | Resource Name | Usage |
|---------------------|---|---|
| Event files | Component event (<code>compEvent.evt</code>) and application event (<code>appEvent.evt</code>) | Defines the component and application events in separate resources. <code>eventsContainer.cmp</code> shows how to use both component and application events. |
| Notifier | Component (<code>eventsNotifier.cmp</code>) and its controller (<code>eventsNotifierController.js</code>) | The notifier contains an <code>onclick</code> browser event to initiate the event. The controller fires the event. |
| Handler | Component (<code>eventsHandler.cmp</code>) and its controller (<code>eventsHandlerController.js</code>) | The handler component contains the notifier component (or a <code><aura:handler></code> tag for application events), and calls the controller action that is executed after the event is fired. |
| Container Component | <code>eventsContainer.cmp</code> | Displays the event handlers on the UI for the complete demo. |

The definitions of component and application events are stored in separate `.evt` resources, but individual notifier and handler component bundles can contain code to work with both types of events.

The component and application events both contain a `context` attribute that defines the shape of the event. This is the data that is passed to handlers of the event.

Component Event

Here is the markup for `compEvent.evt`.

```
<!--c:compEvent-->
<aura:event type="COMPONENT">
    <!-- pass context of where the event was fired to the handler. --&gt;
    &lt;aura:attribute name="context" type="String"/&gt;
&lt;/aura:event&gt;</pre>

```

Application Event

Here is the markup for `appEvent.evt`.

```
<!--c:appEvent-->
<aura:event type="APPLICATION">
    <!-- pass context of where the event was fired to the handler. --&gt;
    &lt;aura:attribute name="context" type="String"/&gt;
&lt;/aura:event&gt;</pre>

```

Notifier Component

The `eventsNotifier cmp` notifier component contains buttons to initiate a component or application event.

The notifier uses `aura:registerEvent` tags to declare that it may fire the component and application events. Note that the `name` attribute is required but the value is only relevant for the component event; the value is not used anywhere else for the application event.

The `parentName` attribute is not set yet. We will see how this attribute is set and surfaced in `eventsContainer cmp`.

```
<!--c:eventsNotifier-->
<aura:component>
    <aura:attribute name="parentName" type="String"/>
    <aura:registerEvent name="componentEventFired" type="c:compEvent"/>
    <aura:registerEvent name="appEvent" type="c:appEvent"/>

    <div>
        <h3>This is {!v.parentName}'s eventsNotifier cmp instance</h3>
        <p><ui:button
            label="Click here to fire a component event"
            press=" {!c.fireComponentEvent} " />
        </p>
        <p><ui:button
            label="Click here to fire an application event"
            press=" {!c.fireApplicationEvent} " />
        </p>
    </div>
</aura:component>
```

CSS source

The CSS is in `eventsNotifier.css`.

```
/* eventsNotifier.css */
.cEventsNotifier {
```

```

    display: block;
    margin: 10px;
    padding: 10px;
    border: 1px solid black;
}

```

Client-side controller source

The `eventsNotifierController.js` controller fires the event.

```

/* eventsNotifierController.js */
{
    fireComponentEvent : function(cmp, event) {
        var parentName = cmp.get("v.parentName");

        // Look up event by name, not by type
        var compEvents = cmp.getEvent("componentEventFired");

        compEvents.setParams({ "context" : parentName });
        compEvents.fire();
    },

    fireApplicationEvent : function(cmp, event) {
        var parentName = cmp.get("v.parentName");

        // note different syntax for getting application event
        var appEvent = $A.get("e.c:appEvent");

        appEvent.setParams({ "context" : parentName });
        appEvent.fire();
    }
}

```

You can click the buttons to fire component and application events but there is no change to the output because we haven't wired up the handler component to react to the events yet.

The controller sets the `context` attribute of the component or application event to the `parentName` of the notifier component before firing the event. We will see how this affects the output when we look at the handler component.

Handler Component

The `eventsHandler.cmp` handler component contains the `c:eventsNotifier` notifier component and `<aura:handler>` tags for the application and component events.

```

<!--c:eventsHandler-->
<aura:component>
    <aura:attribute name="name" type="String"/>
    <aura:attribute name="mostRecentEvent" type="String" default="Most recent event handled:"/>

    <aura:attribute name="numComponentEventsHandled" type="Integer" default="0"/>
    <aura:attribute name="numApplicationEventsHandled" type="Integer" default="0"/>

    <aura:handler event="c:appEvent" action=" {!c.handleApplicationEventFired}"/>
    <aura:handler name="componentEventFired" event="c:compEvent"
        action=" {!c.handleComponentEventFired}"/>

```

```
<div>
  <h3>This is {!v.name}</h3>
  <p>{!v.mostRecentEvent}</p>
  <p># component events handled: {!v.numComponentEventsHandled}</p>
  <p># application events handled: {!v.numApplicationEventsHandled}</p>
  <c:eventsNotifier parentName="#{v.name}" />
</div>
</aura:component>
```

 **Note:** `{#v.name}` is an unbound expression. This means that any change to the value of the `parentName` attribute in `c:eventsNotifier` doesn't propagate back to affect the value of the `name` attribute in `c:eventsHandler`. For more information, see [Data Binding Between Components](#) on page 47.

CSS source

The CSS is in `eventsHandler.css`.

```
/* eventsHandler.css */
.cEventsHandler {
  display: block;
  margin: 10px;
  padding: 10px;
  border: 1px solid black;
}
```

Client-side controller source

The client-side controller is in `eventsHandlerController.js`.

```
/* eventsHandlerController.js */
{
  handleComponentEventFired : function(cmp, event) {
    var context = event.getParam("context");
    cmp.set("v.mostRecentEvent",
      "Most recent event handled: COMPONENT event, from " + context);

    var numComponentEventsHandled =
      parseInt(cmp.get("v.numComponentEventsHandled")) + 1;
    cmp.set("v.numComponentEventsHandled", numComponentEventsHandled);
  },

  handleApplicationEventFired : function(cmp, event) {
    var context = event.getParam("context");
    cmp.set("v.mostRecentEvent",
      "Most recent event handled: APPLICATION event, from " + context);

    var numApplicationEventsHandled =
      parseInt(cmp.get("v.numApplicationEventsHandled")) + 1;
    cmp.set("v.numApplicationEventsHandled", numApplicationEventsHandled);
  }
}
```

The `name` attribute is not set yet. We will see how this attribute is set and surfaced in `eventsContainer cmp`.

You can click buttons and the UI now changes to indicate the type of event. The click count increments to indicate whether it's a component or application event. We aren't finished yet though. Notice that the source of the event is undefined as the event `context` attribute hasn't been set.

Container Component

Here is the markup for `eventsContainer.cmp`.

```
<!--c:eventsContainer-->
<aura:component>
    <c:eventsHandler name="eventsHandler1"/>
    <c:eventsHandler name="eventsHandler2"/>
</aura:component>
```

The container component contains two handler components. It sets the `name` attribute of both handler components, which is passed through to set the `parentName` attribute of the notifier components. This fills in the gaps in the UI text that we saw when we looked at the notifier or handler components directly.

Add the `c:eventsContainer` component to a `c:eventsContainerApp` application. Navigate to the application.

<https://<myDomain>.lightning.force.com/c/eventsContainerApp.app>, where `<myDomain>` is the name of your custom Salesforce domain.

Click the **Click here to fire a component event** button for either of the event handlers. Notice that the **# component events handled** counter only increments for that component because only the firing component's handler is notified.

Click the **Click here to fire an application event** button for either of the event handlers. Notice that the **# application events handled** counter increments for both the components this time because all the handling components are notified.

SEE ALSO:

[Component Event Example](#)

[Application Event Example](#)

[Event Handling Lifecycle](#)

Firing Lightning Events from Non-Lightning Code

You can fire Lightning events from JavaScript code outside a Lightning app. For example, your Lightning app might need to call out to some non-Lightning code, and then have that code communicate back to your Lightning app once it's done.

For example, you could call external code that needs to log into another system and return some data to your Lightning app. Let's call this event `mynamespace:externalEvent`. You'll fire this event when your non-Lightning code is done by including this JavaScript in your non-Lightning code.

```
var myExternalEvent;
if(window.opener.$A &&
(myExternalEvent = window.opener.$A.get("e.mynamespace:externalEvent"))) {
    myExternalEvent.setParams({isOauthed:true});
    myExternalEvent.fire();
}
```

`window.opener.$A.get()` references the master window where your Lightning app is loaded.

SEE ALSO:

[Application Events](#)

[Modifying Components Outside the Framework Lifecycle](#)

Events Best Practices

Here are some best practices for working with events.

Use Component Events Whenever Possible

Always try to use a component event instead of an application event, if possible. Component events can only be handled by components above them in the containment hierarchy so their usage is more localized to the components that need to know about them. Application events are best used for something that should be handled at the application level, such as navigating to a specific record. Application events allow communication between components that are in separate parts of the application and have no direct containment relationship.

Separate Low-Level Events from Business Logic Events

It's a good practice to handle low-level events, such as a click, in your event handler and refire them as higher-level events, such as an `approvalChange` event or whatever is appropriate for your business logic.

Dynamic Actions based on Component State

If you need to invoke a different action on a click event depending on the state of the component, try this approach:

1. Store the component state as a discrete value, such as New or Pending, in a component attribute.
2. Put logic in your client-side controller to determine the next action to take.
3. If you need to reuse the logic in your component bundle, put the logic in the helper.

For example:

1. Your component markup contains `<ui:button label="do something" press=" {!c.click} " />`.
2. In your controller, define the `click` function, which delegates to the appropriate helper function or potentially fires the correct event.

Using a Dispatcher Component to Listen and Relay Events

If you have a large number of handler component instances listening for an event, it may be better to identify a dispatcher component to listen for the event. The dispatcher component can perform some logic to decide which component instances should receive further information and fire another component or application event targeted at those component instances.

SEE ALSO:

[Handling Events with Client-Side Controllers](#)

[Events Anti-Patterns](#)

Events Anti-Patterns

These are some anti-patterns that you should avoid when using events.

Don't Fire an Event in a Renderer

Firing an event in a renderer can cause an infinite rendering loop.

Don't do this!

```
afterRender: function(cmp, helper) {
    this.superAfterRender();
    $A.get("e.myns:mycmp").fire();
}
```

Instead, use the `init` hook to run a controller action after component construction but before rendering. Add this code to your component:

```
<aura:handler name="init" value="{!this}" action="{!!c.doInit}"/>
```

For more details, see [Invoking Actions on Component Initialization](#) on page 340.

Don't Use `onclick` and `ontouchend` Events

You can't use different actions for `onclick` and `ontouchend` events in a component. The framework translates touch-tap events into clicks and activates any `onclick` handlers that are present.

SEE ALSO:

[Create a Custom Renderer](#)

[Events Best Practices](#)

Events Fired During the Rendering Lifecycle

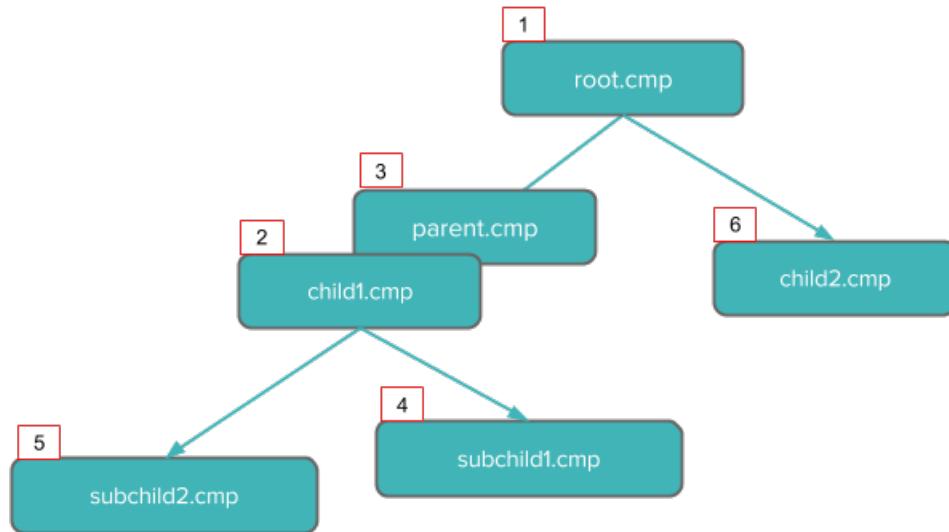
A component is instantiated, rendered, and rerendered during its lifecycle. A component is rerendered only when there's a programmatic or value change that would require a rerender, such as when a browser event triggers an action that updates its data.

Component Creation

The component lifecycle starts when the client sends an HTTP request to the server and the component configuration data is returned to the client. No server trip is made if the component definition is already on the client from a previous request and the component has no server dependencies.

Let's look at an app with several nested components. The framework instantiates the app and goes through the children of the `v.body` facet to create each component. First, it creates the component definition, its entire parent hierarchy, and then creates the facets within those components. The framework also creates any component dependencies on the server, including definitions for attributes, interfaces, controllers, and actions.

The following image lists the order of component creation.



After creating a component instance, the serialized component definitions and instances are sent down to the client. Definitions are cached but not the instance data. The client deserializes the response to create the JavaScript objects or maps, resulting in an instance tree that's used to render the component instance. When the component tree is ready, the `init` event is fired for all the components, starting from the children component and finishing in the parent component.

Component Rendering

The rendering lifecycle happens once in the lifetime of a component unless the component gets explicitly unrendered. When you create a component:

1. The component service that constructs the components fires the `init` event to signal that initialization has completed.

```
<aura:handler name="init" value="{!this}" action="{!!c.doInit}"/>
```

You can customize the `init` handler and add your own controller logic before the component starts rendering. For more information, see [Invoking Actions on Component Initialization](#) on page 340.

2. For each component in the tree, the base implementation of `render()` or your custom renderer is called to start component rendering. For more information, see [Create a Custom Renderer](#) on page 357. Similar to the component creation process, rendering starts at the root component, its children components and their super components, if any, and finally the subchildren components.
3. Once your components are rendered to the DOM, `afterRender()` is called to signal that rendering is completed for each of these component definitions. It enables you to interact with the DOM tree after the framework rendering service has created the DOM elements.
4. To indicate that the client is done waiting for a response to the server request XHR, the `aura:doneWaiting` event is fired. You can handle this event by adding a handler wired to a client-side controller action.

 **Note:** The `aura:doneWaiting` event is deprecated. The `aura:doneWaiting` application event is fired for every server response, even for responses from other components in your app. Unless your component is running in complete isolation in a standalone app and not included in Lightning Experience or the Salesforce app, the container app may trigger your event handler multiple times. This behavior makes it difficult to handle each event appropriately.

5. The framework fires a `render` event, enabling you to interact with the DOM tree after the framework's rendering service has inserted DOM elements. Handling the `render` event is preferred to creating a custom renderer and overriding `afterRender()`. For more information, see [Handle the render Event](#).

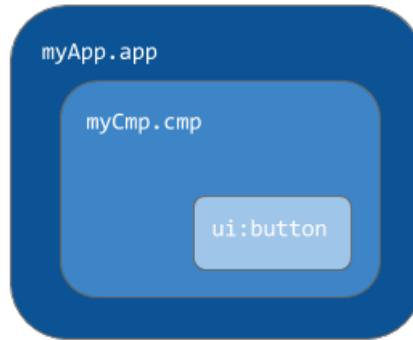
- Finally, the `aura:doneRendering` event is fired at the end of the rendering lifecycle.



Note: The `aura:doneRendering` event is deprecated. Unless your component is running in complete isolation in a standalone app and not included in complex apps, such as Lightning Experience or the Salesforce app, the container app may trigger your event handler multiple times. This behavior makes it difficult to handle each event appropriately.

Rendering Nested Components

Let's say that you have an app `myApp.app` that contains a component `myCmp.cmp` with a `ui:button` component.



During initialization, the `init()` event is fired in this order: `ui:button`, `ui:myCmp`, and `myApp.app`.

SEE ALSO:

[Create a Custom Renderer](#)

Events Handled in the Salesforce Mobile App and Lightning Experience

The Salesforce mobile app and Lightning Experience handle some events, which you can fire in your Aura component.

If you fire one of these `force` or `lightning` events in your Lightning apps or components outside of the Salesforce app or Lightning Experience:

- You must handle the event by using the `<aura:handler>` tag in the handling component.
- Use the `<aura:registerEvent>` or `<aura:dependency>` tags to ensure that the event is sent to the client, when needed.

| Event Name | Description |
|---|--|
| <code>force:closeQuickAction</code> | Closes a quick action panel. Only one quick action panel can be open in the app at a time. |
| <code>force:createRecord</code> | Opens a page to create a record for the specified <code>entityApiName</code> , for example, "Account" or "myNamespace__MyObject__c". |
| <code>force:editRecord</code> | Opens the page to edit the record specified by <code>recordId</code> . |
| <code>force:navigateToComponent</code> (Beta) | Navigates from one Aura component to another. |
| <code>force:navigateToList</code> | Navigates to the list view specified by <code>listViewId</code> . |

| Event Name | Description |
|-----------------------------|---|
| force:navigateToObjectHome | Navigates to the object home specified by the <code>scope</code> attribute. |
| force:navigateToRelatedList | Navigates to the related list specified by <code>parentRecordId</code> . |
| force:navigateToSObject | Navigates to an sObject record specified by <code>recordId</code> . |
| force:navigateToURL | Navigates to the specified URL. |
| force:recordSave | Saves a record. |
| force:recordSaveSuccess | Indicates that the record has been successfully saved. |
| force:refreshView | Reloads the view. |
| force:showToast | Displays a toast notification with a message. (Not available on login pages.) |
| lightning:openFiles | Opens one or more file records from the ContentDocument and ContentHubItem objects. |

Customizing Client-Side Logic for the Salesforce app, Lightning Experience, and Standalone Apps

Since the Salesforce app and Lightning Experience automatically handle many events, you have to do extra work if your component runs in a standalone app. Instantiating the event using `$A.get()` can help you determine if your component is running within the Salesforce app and Lightning Experience or a standalone app. For example, you want to display a toast when a component loads in the Salesforce app and Lightning Experience. You can fire the `force:showToast` event and set its parameters for the Salesforce app and Lightning Experience, but you have to create your own implementation for a standalone app.

```
displayToast : function (component, event, helper) {
    var toast = $A.get("e.force:showToast");
    if (toast) {
        //fire the toast event in Salesforce app and Lightning Experience
        toast.setParams({
            "title": "Success!",
            "message": "The component loaded successfully."
        });
        toast.fire();
    } else {
        //your toast implementation for a standalone app here
    }
}
```

SEE ALSO:

[aura:dependency](#)
[Fire Component Events](#)
[Fire Application Events](#)

System Events

The framework fires several system events during its lifecycle.

You can handle these events in your Lightning apps or components, and within the Salesforce mobile app.

For examples, see the [Component Library](#).

| Event Name | Description |
|---------------------------------|--|
| aura:doneRendering (deprecated) | Indicates that the initial rendering of the root application has completed. |
| |  Note: The aura:doneRendering event is deprecated. Unless your component is running in complete isolation in a standalone app and not included in complex apps, such as Lightning Experience or the Salesforce app, the container app may trigger your event handler multiple times. This behavior makes it difficult to handle each event appropriately. |
| aura:doneWaiting (deprecated) | Indicates that the app is done waiting for a response to a server request. This event is preceded by an aura:waiting event. |
| |  Note: The aura:doneWaiting event is deprecated. The aura:doneWaiting application event is fired for every server response, even for responses from other components in your app. Unless your component is running in complete isolation in a standalone app and not included in Lightning Experience or the Salesforce app, the container app may trigger your event handler multiple times. This behavior makes it difficult to handle each event appropriately. |
| aura:locationChange | Indicates that the hash part of the URL has changed. |
| aura:noAccess | Indicates that a requested resource is not accessible due to security constraints on that resource. |
| aura:systemError | Indicates that an error has occurred. |
| aura:valueChange | Indicates that an attribute value has changed. |
| aura:valueDestroy | Indicates that a component has been destroyed. |
| aura:valueInit | Indicates that an app or component has been initialized. |
| aura:valueRender | Indicates that an app or component has been rendered or rerendered. |
| aura:waiting (deprecated) | Indicates that the app is waiting for a response to a server request. |
| |  Note: The aura:waiting event is deprecated. The aura:waiting application event is fired for every server request, even for requests from other components in your app. Unless your component is running in complete isolation in a standalone app and not included in Lightning Experience or the Salesforce app, the container app may trigger your event handler multiple times. This behavior makes it difficult to handle each event appropriately. |

CHAPTER 6 Creating Apps

In this chapter ...

- [App Overview](#)
- [Designing App UI](#)
- [Creating App Templates](#)
- [Using the AppCache](#)
- [Distributing Applications and Components](#)

Components are the building blocks of an app. This section shows you a typical workflow to put the pieces together to create a new app.

First, you should decide whether you're creating a component for a standalone app or for Salesforce apps, such as Lightning Experience or Salesforce for Android, iOS, and mobile web. Both components can access your Salesforce data, but only a component created for Lightning Experience or Salesforce for Android, iOS, and mobile web can automatically handle Salesforce events that take advantage of record create and edit pages, among other benefits.

The [Quick Start](#) on page 8 walks you through creating components for a standalone app and components for Salesforce for Android, iOS, and mobile web to help you determine which one you need.

App Overview

An app is a special top-level component whose markup is in a `.app` resource.

On a production server, the `.app` resource is the only addressable unit in a browser URL. Access an app using the URL:

`https://<myDomain>.lightning.force.com/<namespace>/<appName>.app`, where `<myDomain>` is the name of your custom Salesforce domain

SEE ALSO:

[aura:application](#)

[Supported HTML Tags](#)

Designing App UI

Design your app's UI by including markup in the `.app` resource. Each part of your UI corresponds to a component, which can in turn contain nested components. Compose components to create a sophisticated app.

An app's markup starts with the `<aura:application>` tag.

 **Note:** Creating a standalone app enables you to host your components outside of Salesforce for Android, iOS, and mobile web or Lightning Experience, such as with Lightning Out or Lightning components in Visualforce pages. To learn more about the `<aura:application>` tag, see [aura:application](#).

Let's look at a `sample.app` file, which starts with the `<aura:application>` tag.

```
<aura:application extends="force:slds">
    <lightning:layout>
        <lightning:layoutItem padding="around-large">
            <h1 class="slds-text-heading_large">Sample App</h1>
        </lightning:layoutItem>
    </lightning:layout>
    <lightning:layout>
        <lightning:layoutItem padding="around-small">
            Sidebar
            <!-- Other component markup here -->
        </lightning:layoutItem>
        <lightning:layoutItem padding="around-small">
            Content
            <!-- Other component markup here -->
        </lightning:layoutItem>
    </lightning:layout>

</aura:application>
```

The `sample.app` file contains HTML tags, such as `<h1>`, as well as components, such as `<lightning:layout>`. We won't go into the details for all the components here but note how simple the markup is. The `<lightning:layoutItem>` component can contain other components or HTML markup.

SEE ALSO:

[aura:application](#)

Creating App Templates

An app template bootstraps the loading of the framework and the app. Customize an app's template by creating a component that extends the default `aura:template` template.

A template must have the `isTemplate` system attribute in the `<aura:component>` tag set to `true`. This informs the framework to allow restricted items, such as `<script>` tags, which aren't allowed in regular components.

For example, a sample app has a `np:template` template that extends `aura:template`. `np:template` looks like:

```
<aura:component isTemplate="true" extends="aura:template">
    <aura:set attribute="title" value="My App"/>
    ...
</aura:component>
```

Note how the component extends `aura:template` and sets the `title` attribute using `aura:set`.

The app points at the custom template by setting the `template` system attribute in `<aura:application>`.

```
<aura:application template="np:template">
    ...
</aura:application>
```

A template can only extend a component or another template. A component or an application can't extend a template.

Using the AppCache

AppCache support is deprecated. Browser vendors have deprecated AppCache, so we followed their lead. Remove the `useAppcache` attribute in the `<aura:application>` tag of your standalone apps (.app resources) to avoid cross-browser support issues due to deprecation by browser vendors.

If you don't currently set `useAppcache` in an `<aura:application>` tag, you don't have to do anything because the default value of `useAppcache` is `false`.



Note: See an introduction to AppCache for more information.

SEE ALSO:

[aura:application](#)

Distributing Applications and Components

As an ISV or Salesforce partner, you can package and distribute applications and components to other Salesforce users and organizations, including those outside your company.

Publish applications and components to and install them from AppExchange. When adding an application or component to a package, all definition bundles referenced by the application or component are automatically included, such as other components, events, and interfaces. Custom fields, custom objects, list views, page layouts, and Apex classes referenced by the application or component are also included. However, when you add a custom object to a package, the application and other definition bundles that reference that custom object must be explicitly added to the package. Other dependencies that must be explicitly added to a package include the following.

- CSP Trusted Sites
- Remote Site Settings

A managed package ensures that your application and other resources are fully upgradeable. To create and work with managed packages, you must use a Developer Edition organization and register a namespace prefix. A managed package includes your namespace prefix in the component names and prevents naming conflicts in an installer's organization. An organization can create a single managed package that can be downloaded and installed by other organizations. After installation from a managed package, the application or component names are locked, but the following attributes are editable.

- API Version
- Description
- Label
- Language
- Markup

Any Apex that is included as part of your definition bundle must have at least 75% cumulative test coverage. When you upload your package to AppExchange, all tests are run to ensure that they run without errors. The tests are also run when the package is installed.

For more information on packaging and distributing, see the [ISVforce Guide](#).

SEE ALSO:

[Testing Your Apex Code](#)

CHAPTER 7 Styling Apps

In this chapter ...

- [Using the Salesforce Lightning Design System in Apps](#)
- [Using External CSS](#)
- [More Readable Styling Markup with the join Expression](#)
- [Tips for CSS in Components](#)
- [Vendor Prefixes](#)
- [Styling with Design Tokens](#)

An app is a special top-level component whose markup is in a `.app` resource. Just like any other component, you can put CSS in its bundle in a resource called `<appName>.css`.

For example, if the app markup is in `notes.app`, its CSS is in `notes.css`.

When viewed in Salesforce for Android, iOS, and mobile web and Lightning Experience, the UI components include styling that matches those visual themes. For example, the `ui:button` includes the `button--neutral` class to display a neutral style. The input components that extend `ui:input` include the `uiInput--input` class to display the input fields using a custom font in addition to other styling.



Note: Styles added to UI components in Salesforce for Android, iOS, and mobile web and Lightning Experience don't apply to components in standalone apps.

SEE ALSO:

[CSS in Components](#)

[Add Lightning Components as Custom Tabs in the Salesforce App](#)

Using the Salesforce Lightning Design System in Apps

The Salesforce Lightning Design System (SLDS) provides a look and feel that's consistent with Lightning Experience. Use Lightning Design System styles to give your custom stand-alone Lightning applications a UI that is consistent with Salesforce, without having to reverse-engineer our styles.

Your application automatically gets Lightning Design System styles and design tokens if it extends `force:slds`. This method is the easiest way to stay up to date and consistent with Lightning Design System enhancements.

To extend `force:slds`:

```
<aura:application extends="force:slds">
    <!-- customize your application here -->
</aura:application>
```

Using a Static Resource

When you extend `force:slds`, the version of Lightning Design System styles is automatically updated whenever the CSS changes. If you want to use a specific Lightning Design System version, download the version and add it to your org as a static resource.



Note: We recommend extending `force:slds` instead so that you automatically get the latest Lightning Design System styles. If you stick to a specific Lightning Design System version, your app's styles will gradually start to drift from later versions in Lightning Experience or incur the cost of duplicate CSS downloads.

To download a version of Lightning Design System that doesn't exceed the maximum size for a static resource, go to the Lightning Design System [downloads page](#).

Salesforce recommends that you name the Lightning Design System archive static resource using the name format SLDS###, where ### is the Lightning Design System version number (for example, `SLDS252`). This lets you have multiple versions of the Lightning Design System installed, and manage version usage in your components.

To use the static version of the Lightning Design System in a component, include it using `<ltn:require>`. For example:

```
<aura:component>
    <ltn:require
        styles="{$Resource.SLDS252 +
            '/styles/salesforce-lightning-design-system.min.css'}" />
</aura:component>
```

SEE ALSO:

[Styling with Design Tokens](#)

Using External CSS

To reference an external CSS resource that you've uploaded as a static resource, use a `<ltn:require>` tag in your `.cmp` or `.app` markup.

Here's an example of using `<ltn:require>`:

```
<ltn:require styles="{$Resource.resourceName}" />
```

`resourceName` is the Name of the static resource. In a managed packaged, the resource name must include the package namespace prefix, such as `$Resource.yourNamespace__resourceName`. For a stand-alone static resource, such as an individual graphic

or script, that's all you need. To reference an item within an archive static resource, add the rest of the path to the item using string concatenation.

Here are some considerations for loading styles:

Loading Sets of CSS

Specify a comma-separated list of resources in the `styles` attribute to load a set of CSS.

 **Note:** Due to a quirk in the way `$Resource` is parsed in expressions, use the `join` operator to include multiple `$Resource` references in a single attribute. For example, if you have more than one style sheet to include into a component the `styles` attribute should be something like the following.

```
styles="={!join(',',
    $Resource.myStyles + '/stylesheetOne.css',
    $Resource.myStyles + '/moreStyles.css')}"
```

Loading Order

The styles are loaded in the order that they are listed.

One-Time Loading

The styles load only once, even if they're specified in multiple `<ltng:require>` tags in the same component or across different components.

Encapsulation

To ensure encapsulation and reusability, add the `<ltng:require>` tag to every `.cmp` or `.app` resource that uses the CSS resource.

`<ltng:require>` also has a `scripts` attribute to load a list of JavaScript libraries. The `afterScriptsLoaded` event enables you to call a controller action after the `scripts` are loaded. It's only triggered by loading of the `scripts` and is never triggered when the CSS in `styles` is loaded.

For more information on static resources, see "Static Resources" in the Salesforce online help.

Styling Components for Lightning Experience or Salesforce for Android, iOS, and mobile web

To prevent styling conflicts in Lightning Experience or Salesforce for Android, iOS, and mobile web, prefix your external CSS with a unique namespace. For example, if you prefix your external CSS declarations with `.myBootstrap`, wrap your component markup with a `<div>` tag that specifies the `myBootstrap` class.

```
<ltng:require styles=" {!$Resource.bootstrap} "/>
<div class="myBootstrap">
    <c:myComponent />
    <!-- Other component markup -->
</div>
```

 **Note:** Prefixing your CSS with a unique namespace only applies to external CSS. If you're using CSS within a component bundle, the `.THIS` keyword becomes `.namespaceComponentName` during runtime.

SEE ALSO:

[Using External JavaScript Libraries](#)

[CSS in Components](#)

[\\$Resource](#)

More Readable Styling Markup with the `join` Expression

Markup can get messy when you specify the class names to apply based on the component attribute values. Try using a `join` expression for easier-to-read markup.

This example sets the class names based on the component attribute values. It's readable, but the spaces between class names are easy to forget.

```
<li class="{!! 'calendarEvent' +  
    v.zoomDirection + ' ' +  
    (v.past ? 'pastEvent' : '') +  
    (v.zoomed ? 'zoom' : '') +  
    (v.multiDayFragment ? 'multiDayFragment' : '')}">  
    <!-- content here -->  
</li>
```

Sometimes, if the markup is not broken into multiple lines, it can hurt your eyes or make you mutter profanities under your breath.

```
<li class="{!! 'calendarEvent' + v.zoomDirection + ' ' + (v.past ? 'pastEvent' : '') +  
    (v.zoomed ? 'zoom' : '') + (v.multiDayFragment ? 'multiDayFragment' : '')}">  
    <!-- content here -->  
</li>
```

Try using a `join` expression instead for easier-to-read markup. This example `join` expression sets `' '` as the first argument so that you don't have to specify it for each subsequent argument in the expression.

```
<li  
    class="{!! join(' ',  
        'calendarEvent',  
        v.zoomDirection,  
        v.past ? 'pastEvent' : '',  
        v.zoomed ? 'zoom' : '',  
        v.multiDayFragment ? 'multiDayFragment' : ''  
    )}">  
    <!-- content here -->  
</li>
```

You can also use a `join` expression for dynamic styling.

```
<div style="{!! join(';',  
    'top:' + v.timeOffsetTop + '%',  
    'left:' + v.timeOffsetLeft + '%',  
    'width:' + v.timeOffsetWidth + '%'  
)}">  
    <!-- content here -->  
</div>
```

SEE ALSO:

[Expression Functions Reference](#)

Tips for CSS in Components

Here are some tips for configuring the CSS for components that you plan to use in Lightning pages, the Lightning App Builder, or the Community Builder.

Components must be set to 100% width

Because they can be moved to different locations on a Lightning page, components must not have a specific width nor a left or right margin. Components should take up 100% of whatever container they display in. Adding a left or right margin changes the width of a component and can break the layout of the page.

Don't remove HTML elements from the flow of the document

Some CSS rules remove the HTML element from the flow of the document. For example:

```
float: left;  
float: right;  
position: absolute;  
position: fixed;
```

Because they can be moved to different locations on the page as well as used on different pages entirely, components must rely on the normal document flow. Using floats and absolute or fixed positions breaks the layout of the page the component is on. Even if they don't break the layout of the page *you're* looking at, they will break the layout of *some* page the component can be put on.

Child elements shouldn't be styled to be larger than the root element

The Lightning page maintains consistent spacing between components, and can't do that if child elements are larger than the root element.

For example, avoid these patterns:

```
<div style="height: 100px">  
  <div style="height: 200px">  
    <!--Other markup here-->  
  </div>  
</div>  
  
<!--Margin increases the element's effective size-->  
<div style="height: 100px">  
  <div style="height: 100px margin: 10px">  
    <!--Other markup here-->  
  </div>  
</div>
```

Vendor Prefixes

Vendor prefixes, such as `-moz-` and `-webkit-` among many others, are automatically added in Lightning.

You only need to write the unprefixed version, and the framework automatically adds any prefixes that are necessary when generating the CSS output. If you choose to add them, they are used as-is. This enables you to specify alternative values for certain prefixes.

 **Example:** For example, this is an unprefixed version of `border-radius`.

```
.class {  
  border-radius: 2px;  
}
```

The previous declaration results in the following declarations.

```
.class {  
  -webkit-border-radius: 2px;  
  -moz-border-radius: 2px;  
  border-radius: 2px;  
}
```

Styling with Design Tokens

Capture the essential values of your visual design into named tokens. Define the token values once and reuse them throughout your Lightning components CSS resources. Tokens make it easy to ensure that your design is consistent, and even easier to update it as your design evolves.

Design tokens are visual design “atoms” for building a design for your components or apps. Specifically, they’re named entities that store visual design attributes, such as pixel values for margins and spacing, font sizes and families, or hex values for colors. Tokens are a terrific way to centralize the low-level values, which you then use to compose the styles that make up the design of your component or app.

IN THIS SECTION:

[Tokens Bundles](#)

Tokens are a type of bundle, just like components, events, and interfaces.

[Create a Tokens Bundle](#)

Create a tokens bundle in your org using the Developer Console.

[Defining and Using Tokens](#)

A token is a name-value pair that you specify using the `<aura:token>` component. Define tokens in a tokens bundle, and then use tokens in your components’ CSS styles resources.

[Using Expressions in Tokens](#)

Tokens support a restricted set of expressions. Use expressions to reuse one token value in another token, or to combine tokens to form a more complex style property.

[Extending Tokens Bundles](#)

Use the `extends` attribute to extend one tokens bundle from another.

[Using Standard Design Tokens](#)

Salesforce exposes a set of “base” tokens that you can access in your component style resources. Use these standard tokens to mimic the look-and-feel of the Salesforce Lightning Design System (SLDS) in your own custom components. As the SLDS evolves, components that are styled using the standard design tokens will evolve along with it.

Tokens Bundles

Tokens are a type of bundle, just like components, events, and interfaces.

A tokens bundle contains only one resource, a tokens collection definition.

| Resource | Resource Name | Usage |
|-------------------|-----------------------------------|--|
| Tokens Collection | <code>defaultTokens.tokens</code> | The only required resource in a tokens bundle. Contains markup for one or more tokens. Each tokens bundle contains only one tokens resource. |



Note: You can't edit the tokens bundle name or description in the Developer Console after you create it. The bundle's `AuraBundleDefinition` can be modified using the Metadata API.

A tokens collection starts with the `<aura:tokens>` tag. It can only contain `<aura:token>` tags to define tokens.

Tokens collections have restricted support for expressions; see Using Expressions in Tokens. You can't use other markup, renderers, controllers, or anything else in a tokens collection.

SEE ALSO:

[Using Expressions in Tokens](#)

Create a Tokens Bundle

Create a tokens bundle in your org using the Developer Console.

To create a tokens bundle:

1. In the Developer Console, select **File > New > Lightning Tokens**.
2. Enter a name for the tokens bundle.

Your first tokens bundle should be named `defaultTokens`. The tokens defined within `defaultTokens` are automatically accessible in your Lightning components. Tokens defined in any other bundle won't be accessible in your components unless you import them into the `defaultTokens` bundle.

You have an empty tokens bundle, ready to edit.

```
<aura:tokens>
</aura:tokens>
```



Note: You can't edit the tokens bundle name or description in the Developer Console after you create it. The bundle's `AuraBundleDefinition` can be modified using the Metadata API. Although you can set a version on a tokens bundle, doing so has no effect.

Defining and Using Tokens

A token is a name-value pair that you specify using the `<aura:token>` component. Define tokens in a tokens bundle, and then use tokens in your components' CSS styles resources.

Defining Tokens

Add new tokens as child components of the bundle's `<aura:tokens>` component. For example:

```
<aura:tokens>
  <aura:token name="myBodyTextFontFace">
```

```

        value="'Salesforce Sans', Helvetica, Arial, sans-serif"/>
<aura:token name="myBodyTextFontWeight" value="normal"/>
<aura:token name="myBackgroundColor" value="#f4f6f9"/>
<aura:token name="myDefaultMargin" value="6px"/>
</aura:tokens>

```

The only allowed attributes for the `<aura:token>` tag are `name` and `value`.

Using Tokens

Tokens created in the `defaultTokens` bundle are automatically available in components in your namespace. To use a design token, reference it using the `token()` function and the token name in the CSS resource of a component bundle. For example:

```

.THIS p {
    font-family: token(myBodyTextFontFace);
    font-weight: token(myBodyTextFontWeight);
}

```

If you prefer a more concise function name for referencing tokens, you can use the `t()` function instead of `token()`. The two are equivalent. If your token names follow a naming convention or are sufficiently descriptive, the use of the more terse function name won't affect the clarity of your CSS styles.

Using Expressions in Tokens

Tokens support a restricted set of expressions. Use expressions to reuse one token value in another token, or to combine tokens to form a more complex style property.

Cross-Referencing Tokens

To reference one token's value in another token's definition, wrap the token to be referenced in standard expression syntax.

In the following example, we'll reference tokens provided by Salesforce in our custom tokens. Although you can't see the standard tokens directly, we'll imagine they look something like the following.

```

<!-- force:base tokens (SLDS standard tokens) -->
<aura:tokens>
    ...
    <aura:token name="colorBackground" value="rgb(244, 246, 249)" />
    <aura:token name="fontFamily" value="'Salesforce Sans', Arial, sans-serif" />
    ...
</aura:tokens>

```

With the preceding in mind, you can reference the standard tokens in your custom tokens, as in the following.

```

<!-- defaultTokens.tokens (your tokens) -->
<aura:tokens extends="force:base">
    <aura:token name="mainColor" value="{'! colorBackground }" />
    <aura:token name="btnColor" value="{'! mainColor }" />
    <aura:token name="myFont" value="{'! fontFamily }" />
</aura:tokens>

```

You can only cross-reference tokens defined in the same file or a parent.

Expression syntax in tokens resources is restricted to references to other tokens.

Combining Tokens

To support combining individual token values into more complex CSS style properties, the `token()` function supports string concatenation. For example, if you have the following tokens defined:

```
<!-- defaultTokens.tokens (your tokens) -->
<aura:tokens>
  <aura:token name="defaultHorizontalSpacing" value="12px" />
  <aura:token name="defaultVerticalSpacing" value="6px" />
</aura:tokens>
```

You can combine these two tokens in a CSS style definition. For example:

```
/* myComponent.css */
.THIS div.notification {
  margin: token(defaultVerticalSpacing + ' ' + defaultHorizontalSpacing);
  /* more styles here */
}
```

You can mix tokens with strings as much as necessary to create the right style definition. For example, use `margin: token(defaultVerticalSpacing + ' ' + defaultHorizontalSpacing + ' 3px');` to hard code the bottom spacing in the preceding definition.

The only operator supported within the `token()` function is "+" for string concatenation.

SEE ALSO:

[Defining and Using Tokens](#)

Extending Tokens Bundles

Use the `extends` attribute to extend one tokens bundle from another.

To add tokens from one bundle to another, extend the "child" tokens bundle from the "parent" tokens, like this.

```
<aura:tokens extends="yourNamespace:parentTokens">
  <!-- additional tokens here -->
</aura:tokens>
```

Overriding tokens values works mostly as you'd expect: tokens in a child tokens bundle override tokens with the same name from a parent bundle. The exception is if you're using standard tokens. You can't override standard tokens in Lightning Experience or the Salesforce app.

! **Important:** Overriding standard token values is undefined behavior and unsupported. If you create a token with the same name as a standard token, it overrides the standard token's value in some contexts, and has no effect in others. This behavior will change in a future release. Don't use it.

SEE ALSO:

[Using Standard Design Tokens](#)

Using Standard Design Tokens

Salesforce exposes a set of “base” tokens that you can access in your component style resources. Use these standard tokens to mimic the look-and-feel of the Salesforce Lightning Design System (SLDS) in your own custom components. As the SLDS evolves, components that are styled using the standard design tokens will evolve along with it.

To add the standard tokens to your org, extend a tokens bundle from the base tokens, like so.

```
<aura:tokens extends="force:base">
    <!-- your own tokens here -->
</aura:tokens>
```

Once added to `defaultTokens` (or another tokens bundle that `defaultTokens` extends) you can reference tokens from `force:base` just like your own tokens, using the `token()` function and token name. For example:

```
.THIS p {
    font-family: token(fontFamily);
    font-weight: token(fontWeightRegular);
}
```

You can mix-and-match your tokens with the standard tokens. It's a best practice to develop a naming system for your own tokens to make them easily distinguishable from standard tokens. Consider prefixing your token names with “my”, or something else easily identifiable.

IN THIS SECTION:

[Overriding Standard Tokens \(Developer Preview\)](#)

Standard tokens provide the look-and-feel of the Lightning Design System in your custom components. You can override standard tokens to customize and apply branding to your Lightning apps.

[Standard Design Tokens—force:base](#)

The standard tokens available are a subset of the design tokens offered in the Salesforce Lightning Design System (SLDS). The following tokens are available when extending from `force:base`.

[Standard Design Tokens for Communities](#)

Use a subset of the standard design tokens to make your components compatible with the Theme panel in Community Builder. The Theme panel enables administrators to quickly style an entire community using these properties. Each property in the Theme panel maps to one or more standard design tokens. When an administrator updates a property in the Theme panel, the system automatically updates any Lightning components that use the tokens associated with that branding property.

SEE ALSO:

[Extending Tokens Bundles](#)

Overriding Standard Tokens (Developer Preview)

Standard tokens provide the look-and-feel of the Lightning Design System in your custom components. You can override standard tokens to customize and apply branding to your Lightning apps.



Note: Overriding standard tokens is available as a developer preview. This feature isn't generally available unless or until Salesforce announces its general availability in documentation or in press releases or public statements. You can provide feedback and suggestions for this feature on the [IdeaExchange](#).

To override a standard token for your Lightning app, create a tokens bundle with a unique name, for example `myOverrides`. In the tokens resource, redefine the value for a standard token:

```
<aura:tokens>
  <aura:token name="colorTextBrand" value="#8d7d74"/>
</aura:tokens>
```

In your Lightning app, specify the tokens bundle in the `tokens` attribute:

```
<aura:application tokens="c:myOverrides">
  <!-- Your app markup here -->
</aura:application>
```

Token overrides apply across your app, including resources and components provided by Salesforce and components of your own that use tokens.

Packaging apps that use the `tokens` attribute is unsupported.

! **Important:** Overriding standard token values within `defaultTokens.tokens`, a required resource in a tokens bundle, is unsupported. If you create a token with the same name as a standard token, it overrides the standard token's value in some contexts, and has no effect in others. Overrides should only be done in a separate resource as described above.

SEE ALSO:

[Standard Design Tokens—force:base](#)

Standard Design Tokens—`force:base`

The standard tokens available are a subset of the design tokens offered in the Salesforce Lightning Design System (SLDS). The following tokens are available when extending from `force:base`.

Available Tokens

! **Important:** The standard token values evolve along with SLDS. Available tokens and their values can change without notice. Token values presented here are for example only.

| Token Name | Example Value |
|--------------------------------|---------------|
| <code>borderWidthThin</code> | 1px |
| <code>borderWidthThick</code> | 2px |
| <code>spacingXxxSmall</code> | 0.125rem |
| <code>spacingXxSmall</code> | 0.25rem |
| <code>spacingXSmall</code> | 0.5rem |
| <code>spacingSmall</code> | 0.75rem |
| <code>spacingMedium</code> | 1rem |
| <code>spacingLarge</code> | 1.5rem |
| <code>spacingXLarge</code> | 2rem |
| <code>varSpacingXxSmall</code> | 0.25rem |

| Token Name | Example Value |
|-----------------------------|---------------|
| varSpacingXSmall | 0.5rem |
| varSpacingSmall | 0.75rem |
| varSpacingMedium | 1rem |
| varSpacingLarge | 1.5rem |
| varSpacingXLarge | 2rem |
| varSpacingXXLarge | 3rem |
| varSpacingVerticalXXSmall | 0.25rem |
| varSpacingVerticalXSmall | 0.5rem |
| varSpacingVerticalSmall | 0.75rem |
| varSpacingVerticalMedium | 1rem |
| varSpacingVerticalLarge | 1.5rem |
| varSpacingVerticalXLarge | 2rem |
| varSpacingVerticalXXLarge | 3rem |
| varSpacingHorizontalXXSmall | 0.25rem |
| varSpacingHorizontalXSmall | 0.5rem |
| varSpacingHorizontalSmall | 0.75rem |
| varSpacingHorizontalMedium | 1rem |
| varSpacingHorizontalLarge | 1.5rem |
| varSpacingHorizontalXLarge | 2rem |
| varSpacingHorizontalXXLarge | 3rem |
| sizeXXSmall | 6rem |
| sizeXSmall | 12rem |
| sizeSmall | 15rem |
| sizeMedium | 20rem |
| sizeLarge | 25rem |
| sizeXLarge | 40rem |
| sizeXXLarge | 60rem |
| squareIconUtilitySmall | 1rem |
| squareIconUtilityMedium | 1.25rem |
| squareIconUtilityLarge | 1.5rem |

| Token Name | Example Value |
|-----------------------------|--------------------------------------|
| squareIconLargeBoundary | 3rem |
| squareIconLargeBoundaryAlt | 5rem |
| squareIconLargeContent | 2rem |
| squareIconMediumBoundary | 2rem |
| squareIconMediumBoundaryAlt | 2.25rem |
| squareIconMediumContent | 1rem |
| squareIconSmallBoundary | 1.5rem |
| squareIconSmallContent | .75rem |
| squareIconXSmallBoundary | 1.25rem |
| squareIconXSmallContent | .5rem |
| fontWeightLight | 300 |
| fontWeightRegular | 400 |
| fontWeightBold | 700 |
| lineHeightHeading | 1.25 |
| lineHeightText | 1.375 |
| lineHeightReset | 1 |
| lineHeightTab | 2.5rem |
| fontFamily | 'Salesforce Sans', Arial, sans-serif |
| borderRadiusSmall | .125rem |
| borderRadiusMedium | .25rem |
| borderRadiusLarge | .5rem |
| borderRadiusPill | 15rem |
| borderRadiusCircle | 50% |
| colorBorder | rgb(216, 221, 230) |
| colorBorderBrand | rgb(21, 137, 238) |
| colorBorderError | rgb(194, 57, 52) |
| colorBorderSuccess | rgb(75, 202, 129) |
| colorBorderWarning | rgb(255, 183, 93) |
| colorBorderTabSelected | rgb(0, 112, 210) |
| colorBorderSeparator | rgb(244, 246, 249) |

| Token Name | Example Value |
|---|---------------------------|
| colorBorderSeparatorAlt | rgb(216, 221, 230) |
| colorBorderSeparatorInverse | rgb(42, 66, 108) |
| colorBorderRowSelected | rgb(0, 112, 210) |
| colorBorderRowSelectedHover | rgb(21, 137, 238) |
| colorBorderButtonBrand | rgb(0, 112, 210) |
| colorBorderButtonBrandDisabled | rgba(0, 0, 0, 0) |
| colorBorderButtonDefault | rgb(216, 221, 230) |
| colorBorderButtonInverseDisabled | rgba(255, 255, 255, 0.15) |
| colorInputBorder | rgb(216, 221, 230) |
| colorInputBorderActive | rgb(21, 137, 238) |
| colorInputBorderDisabled | rgb(168, 183, 199) |
| colorInputBorderCheckboxSelectedCheckmark | rgb(255, 255, 255) |
| colorBackground | rgb(244, 246, 249) |
| colorBackgroundAlt | rgb(255, 255, 255) |
| colorBackgroundAltInverse | rgb(22, 50, 92) |
| colorBackgroundRowHover | rgb(244, 246, 249) |
| colorBackgroundRowActive | rgb(238, 241, 246) |
| colorBackgroundRowSelected | rgb(240, 248, 252) |
| colorBackgroundRowNew | rgb(217, 255, 223) |
| colorBackgroundInverse | rgb(6, 28, 63) |
| colorBackgroundBrowser | rgb(84, 105, 141) |
| colorBackgroundChromeMobile | rgb(0, 112, 210) |
| colorBackgroundChromeDesktop | rgb(255, 255, 255) |
| colorBackgroundHighlight | rgb(250, 255, 189) |
| colorBackgroundModal | rgb(255, 255, 255) |
| colorBackgroundModalBrand | rgb(0, 112, 210) |
| colorBackgroundNotificationBadge | rgb(194, 57, 52) |
| colorBackgroundNotificationBadgeHover | rgb(0, 95, 178) |
| colorBackgroundNotificationBadgeFocus | rgb(0, 95, 178) |
| colorBackgroundNotificationBadgeActive | rgb(0, 57, 107) |

| Token Name | Example Value |
|--------------------------------------|---------------------------------|
| colorBackgroundNotificationNew | rgb(240, 248, 252) |
| colorBackgroundPayload | rgb(244, 246, 249) |
| colorBackgroundShade | rgb(224, 229, 238) |
| colorBackgroundStencil | rgb(238, 241, 246) |
| colorBackgroundStencilAlt | rgb(224, 229, 238) |
| colorBackgroundScrollbar | rgb(224, 229, 238) |
| colorBackgroundScrollbarTrack | rgb(168, 183, 199) |
| colorBrand | rgb(21, 137, 238) |
| colorBrandDark | rgb(0, 112, 210) |
| colorBackgroundModalButton | rgba(0, 0, 0, 0.07) |
| colorBackgroundModalButtonActive | rgba(0, 0, 0, 0.16) |
| colorBackgroundInput | rgb(255, 255, 255) |
| colorBackgroundInputActive | rgb(255, 255, 255) |
| colorBackgroundInputCheckbox | rgb(255, 255, 255) |
| colorBackgroundInputCheckboxDisabled | rgb(216, 221, 230) |
| colorBackgroundInputCheckboxSelected | rgb(21, 137, 238) |
| colorBackgroundInputDisabled | rgb(224, 229, 238) |
| colorBackgroundInputError | rgb(255, 221, 225) |
| colorBackgroundPill | rgb(255, 255, 255) |
| colorBackgroundToast | rgba(84, 105, 141, 0.95) |
| colorBackgroundToastSuccess | rgb(4, 132, 75) |
| colorBackgroundToastError | rgba(194, 57, 52, 0.95) |
| shadowDrag | 0 2px 4px 0 rgba(0, 0, 0, 0.40) |
| shadowDropDown | 0 2px 3px 0 rgba(0, 0, 0, 0.16) |
| shadowHeader | 0 2px 4px rgba(0, 0, 0, 0.07) |
| shadowButtonFocus | 0 0 3px #0070D2 |
| shadowButtonFocusInverse | 0 0 3px #E0E5EE |
| colorTextActionLabel | rgb(84, 105, 141) |
| colorTextActionLabelActive | rgb(22, 50, 92) |
| colorTextBrand | rgb(21, 137, 238) |

| Token Name | Example Value |
|------------------------------|---------------------------|
| colorTextBrowser | rgb(255, 255, 255) |
| colorTextBrowserActive | rgba(0, 0, 0, 0.4) |
| colorTextDefault | rgb(22, 50, 92) |
| colorTextError | rgb(194, 57, 52) |
| colorTextInputDisabled | rgb(84, 105, 141) |
| colorTextInputFocusInverse | rgb(22, 50, 92) |
| colorTextInputIcon | rgb(159, 170, 181) |
| colorTextInverse | rgb(255, 255, 255) |
| colorTextInverseWeak | rgb(159, 170, 181) |
| colorTextInverseActive | rgb(94, 180, 255) |
| colorTextInverseHover | rgb(159, 170, 181) |
| colorTextLink | rgb(0, 112, 210) |
| colorTextLinkActive | rgb(0, 57, 107) |
| colorTextLinkDisabled | rgb(22, 50, 92) |
| colorTextLinkFocus | rgb(0, 95, 178) |
| colorTextLinkHover | rgb(0, 95, 178) |
| colorTextLinkInverse | rgb(255, 255, 255) |
| colorTextLinkInverseHover | rgba(255, 255, 255, 0.75) |
| colorTextLinkInverseActive | rgba(255, 255, 255, 0.5) |
| colorTextLinkInverseDisabled | rgba(255, 255, 255, 0.15) |
| colorTextModal | rgb(255, 255, 255) |
| colorTextModalButton | rgb(84, 105, 141) |
| colorTextStageLeft | rgb(224, 229, 238) |
| colorTextTabLabel | rgb(22, 50, 92) |
| colorTextTabLabelSelected | rgb(0, 112, 210) |
| colorTextTabLabelHover | rgb(0, 95, 178) |
| colorTextTabLabelFocus | rgb(0, 95, 178) |
| colorTextTabLabelActive | rgb(0, 57, 107) |
| colorTextTabLabelDisabled | rgb(224, 229, 238) |
| colorTextToast | rgb(224, 229, 238) |

| Token Name | Example Value |
|--------------------------------|---------------------------|
| colorTextWeak | rgb(84, 105, 141) |
| colorTextIconBrand | rgb(0, 112, 210) |
| colorTextButtonBrand | rgb(255, 255, 255) |
| colorTextButtonBrandHover | rgb(255, 255, 255) |
| colorTextButtonBrandActive | rgb(255, 255, 255) |
| colorTextButtonBrandDisabled | rgb(255, 255, 255) |
| colorTextButtonDefault | rgb(0, 112, 210) |
| colorTextButtonDefaultHover | rgb(0, 112, 210) |
| colorTextButtonDefaultActive | rgb(0, 112, 210) |
| colorTextButtonDefaultDisabled | rgb(216, 221, 230) |
| colorTextButtonDefaultHint | rgb(159, 170, 181) |
| colorTextButtonInverse | rgb(224, 229, 238) |
| colorTextButtonInverseDisabled | rgba(255, 255, 255, 0.15) |
| colorTextIconDefault | rgb(84, 105, 141) |
| colorTextIconDefaultHint | rgb(159, 170, 181) |
| colorTextIconDefaultHover | rgb(0, 112, 210) |
| colorTextIconDefaultActive | rgb(0, 57, 107) |
| colorTextIconDefaultDisabled | rgb(216, 221, 230) |
| colorTextIconInverse | rgb(255, 255, 255) |
| colorTextIconInverseHover | rgb(255, 255, 255) |
| colorTextIconInverseActive | rgb(255, 255, 255) |
| colorTextIconInverseDisabled | rgba(255, 255, 255, 0.15) |
| colorTextLabel | rgb(84, 105, 141) |
| colorTextPlaceholder | rgb(84, 105, 141) |
| colorTextPlaceholderInverse | rgb(224, 229, 238) |
| colorTextRequired | rgb(194, 57, 52) |
| colorTextPill | rgb(0, 112, 210) |
| durationInstantly | 0s |
| durationImmediately | 0.05s |
| durationQuickly | 0.1s |

| Token Name | Example Value |
|--------------------------------------|---------------------|
| durationPromptly | 0.2s |
| durationSlowly | 0.4s |
| durationPaused | 3.2s |
| colorBackgroundButtonBrand | rgb(0, 112, 210) |
| colorBackgroundButtonBrandActive | rgb(0, 57, 107) |
| colorBackgroundButtonBrandHover | rgb(0, 95, 178) |
| colorBackgroundButtonBrandDisabled | rgb(224, 229, 238) |
| colorBackgroundButtonDefault | rgb(255, 255, 255) |
| colorBackgroundButtonDefaultHover | rgb(244, 246, 249) |
| colorBackgroundButtonDefaultFocus | rgb(244, 246, 249) |
| colorBackgroundButtonDefaultActive | rgb(238, 241, 246) |
| colorBackgroundButtonDefaultDisabled | rgb(255, 255, 255) |
| colorBackgroundButtonIcon | rgba(0, 0, 0, 0) |
| colorBackgroundButtonIconHover | rgb(244, 246, 249) |
| colorBackgroundButtonIconFocus | rgb(244, 246, 249) |
| colorBackgroundButtonIconActive | rgb(238, 241, 246) |
| colorBackgroundButtonIconDisabled | rgb(255, 255, 255) |
| colorBackgroundButtonInverse | rgba(0, 0, 0, 0) |
| colorBackgroundButtonInverseActive | rgba(0, 0, 0, 0.24) |
| colorBackgroundButtonInverseDisabled | rgba(0, 0, 0, 0) |
| lineHeightButton | 1.875rem |
| lineHeightButtonSmall | 1.75rem |
| colorBackgroundAnchor | rgb(244, 246, 249) |

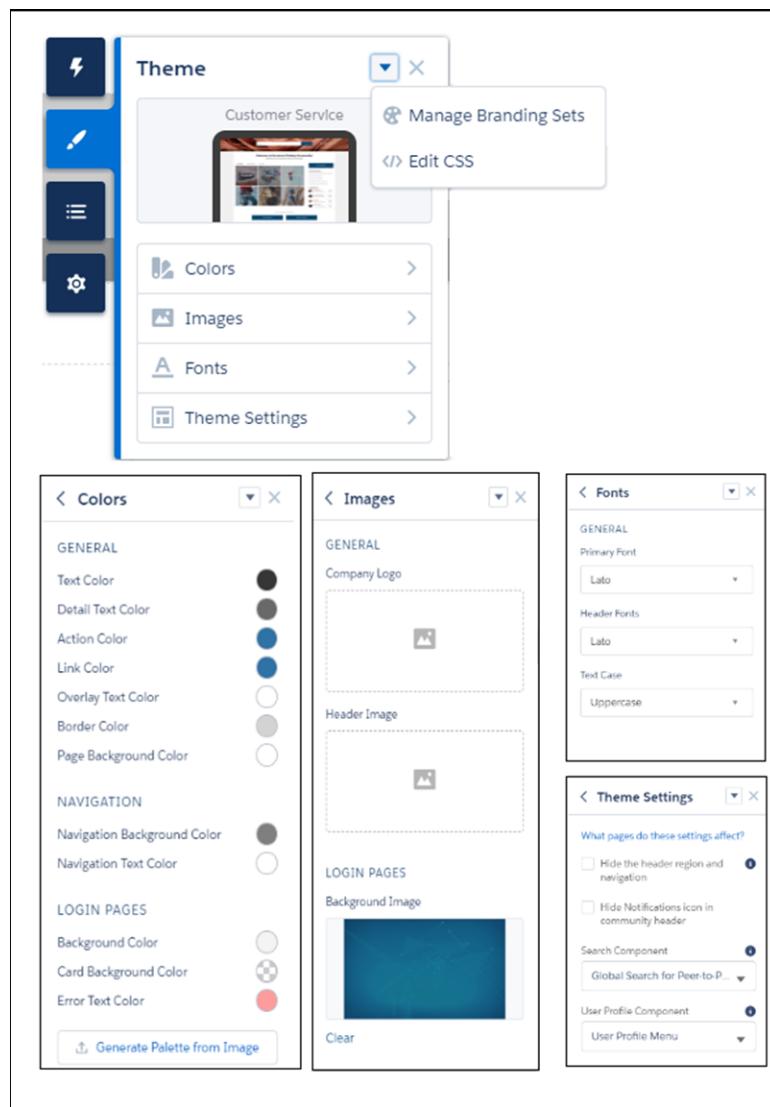
For a complete list of the design tokens available in the SLDS, see [Design Tokens](#) on the Lightning Design System site.

SEE ALSO:

[Extending Tokens Bundles](#)

Standard Design Tokens for Communities

Use a subset of the standard design tokens to make your components compatible with the Theme panel in Community Builder. The Theme panel enables administrators to quickly style an entire community using these properties. Each property in the Theme panel maps to one or more standard design tokens. When an administrator updates a property in the Theme panel, the system automatically updates any Lightning components that use the tokens associated with that branding property.



Available Tokens for Communities

For Communities using the Customer Service template, the following standard tokens are available when extending from `forceCommunity:base`.

! **Important:** The standard token values evolve along with SLDS. Available tokens and their values can change without notice.

| These Branding panel properties... | ...map to these standard design tokens |
|---|---|
| Text Color | colorTextDefault |
| Detail Text Color | <ul style="list-style-type: none"> • colorTextActionButtonLabel • colorTextLabel • colorTextPlaceholder • colorTextWeak |
| Action Color | <ul style="list-style-type: none"> • colorBackgroundButtonBrand • colorBorderBrand • colorBorderButtonBrand • colorBrand • colorTextBrand • colorTextTabLabelSelected • colorTextActionButtonActive <p> Note: As of Summer '18 colorBackgroundHighlight is no longer mapped to Action Color.</p> |
| Link Color | colorTextLink |
| Company Logo | brandLogoImage |
| Overlay Text Color | <ul style="list-style-type: none"> • colorTextButtonBrand • colorTextButtonBrandHover • colorTextInverse |
| Border Color | <ul style="list-style-type: none"> • colorBorder • colorBorderButtonDefault • colorInputBorder • colorBorderSeparatorAlt |
| Primary Font | fontFamily |
| Text Case | textTransform |

In addition, the following standard tokens are available for derived theme properties in the Customer Service template. You can indirectly access derived properties when you update the properties in the Theme panel. For example, if you change the Action Color property in the Theme panel, the system automatically recalculates the Action Color Darker value based on the new value.

| These derived branding properties... | ...map to these standard design tokens |
|---|--|
| Action Color Darker | <ul style="list-style-type: none"> • colorBackgroundButtonBrandActive |
| (Derived from Action Color) | <ul style="list-style-type: none"> • colorBackgroundButtonBrandHover |

These derived branding properties... ...map to these standard design tokens

| | |
|--|---|
| Hover Color (Derived from Action Color) | <ul style="list-style-type: none">colorBackgroundButtonDefaultHovercolorBackgroundRowHovercolorBackgroundRowSelectedcolorBackgroundShade |
| Link Color Darker (Derived from Link Color) | <ul style="list-style-type: none">colorTextLinkActivecolorTextLinkHover |

For a complete list of the design tokens available in the SLDS, see [Design Tokens](#) on the Lightning Design System site.

SEE ALSO:

[Configure Components for Communities](#)

CHAPTER 8 Developing Secure Code

In this chapter ...

- [What is Lightning Locker?](#)
- [Content Security Policy Overview](#)
- [Freeze JavaScript Prototypes](#)

The Lightning Locker architectural layer enhances security by isolating individual Lightning namespaces in their own containers and enforcing coding best practices.

The framework also uses JavaScript Strict mode to turn on native security features in the browser, and Content Security Policy (CSP) rules to control the source of content that can be loaded on a page.

What is Lightning Locker?

Lightning Locker is a powerful security architecture for Lightning components. Lightning Locker enhances security by isolating Lightning components that belong to one namespace from components in a different namespace. Lightning Locker also promotes best practices that improve the supportability of your code by only allowing access to supported APIs and eliminating access to non-published framework internals.

IN THIS SECTION:

[JavaScript Strict Mode Enforcement](#)

Lightning Locker implicitly enables JavaScript strict mode. You don't need to specify "`use strict`" in your code. JavaScript strict mode makes code more secure, robust and supportable.

[DOM Access Containment](#)

A component can only traverse the DOM and access elements created by a component in the same namespace. This behavior prevents the anti-pattern of reaching into DOM elements owned by components in another namespace.

[Secure Wrappers](#)

For security, Lightning Locker restricts the use of global objects by hiding an object or by wrapping it in a secure version of the object. For example, the secure version of `window` is `SecureWindow`. Locker intercepts calls to `window` and uses `SecureWindow` instead. Some methods and properties have different behavior or aren't available on the secure objects.

[eval\(\) Function is Limited by Lightning Locker](#)

In Lightning Locker, use of the `eval()` function is supported to enable use of third-party libraries that evaluate code dynamically. However, it is limited to work only in the global scope of the namespace. The `eval()` function can't access the local variables within the scope in which it's called.

[MIME Types Permitted](#)

Lightning Locker analyzes the MIME types of files sent through the browser. Locker permits some MIME types, sanitizes some MIME types, and blocks the rest.

[Access to Supported JavaScript API Framework Methods Only](#)

You can access published, supported JavaScript API framework methods only. These methods are published in the reference doc app at `https://<myDomain>.lightning.force.com/auradocs/reference.app`, where `<myDomain>` is the name of your custom Salesforce domain. Previously, unsupported methods were accessible, which exposed your code to the risk of breaking when unsupported methods were changed or removed.

[What Does Lightning Locker Affect?](#)

Find out what's affected and what's not affected by Lightning Locker.

[Lightning Locker Tools](#)

Lightning Locker tools help you develop more secure code that is compatible and runs efficiently with Lightning Locker.

[Disabling Lightning Locker for a Component](#)

You can disable Lightning Locker for a component by setting API version 39.0 or lower for the component. If a component is set to at least API version 40.0, Lightning Locker is enabled. API version 40.0 corresponds to Summer '17, when Lightning Locker was enabled for all orgs.

[Don't Mix Component API Versions](#)

For consistency and ease of debugging, we recommend that you set the same API version for all custom components in your app, containment hierarchy (component within component), or extension hierarchy (component extending component).

Lightning Locker Disabled for Unsupported Browsers

Lightning Locker relies on some JavaScript features in the browser: support for strict mode, the `Map` object, and the `Proxy` object. If a browser doesn't meet the requirements, Lightning Locker can't enforce all its security features and is disabled.

SEE ALSO:

- [Content Security Policy Overview](#)
- [Modifying the DOM](#)
- [Component Library](#)
- [Salesforce Lightning CLI \(Deprecated\)](#)
- [Salesforce Help: Supported Browsers for Lightning Experience](#)

JavaScript Strict Mode Enforcement

Lightning Locker implicitly enables JavaScript strict mode. You don't need to specify `"use strict"` in your code. JavaScript strict mode makes code more secure, robust and supportable.

When strict mode is enabled and unsafe actions are taken, JavaScript throws errors that would otherwise be suppressed. Examples of unsafe actions include assigning values to non-writable properties and using a variable that hasn't been declared. Reporting these actions can catch situations when a variable name has been mistyped.

A few common stumbling points when using strict mode are:

- You must declare variables with the `var` keyword.
- You must explicitly attach a variable to the `window` object to create a global variable that's available across components or libraries.
For more information, see [Sharing JavaScript Code Across Components](#).
- The libraries that your components use must also work in strict mode.

For more information about JavaScript strict mode, see the [Mozilla Developer Network](#).

DOM Access Containment

A component can only traverse the DOM and access elements created by a component in the same namespace. This behavior prevents the anti-pattern of reaching into DOM elements owned by components in another namespace.

 **Note:** It's an anti-pattern for any component to "reach into" another component, regardless of namespace, because it breaks encapsulation. Lightning Locker only prevents cross-namespace access. Your good judgment should prevent cross-component access within your own namespace as it makes components tightly coupled and more likely to break.

Let's look at a sample component that demonstrates DOM containment.

```
<!--c:domLocker-->
<aura:component>
    <div id="myDiv" aura:id="div1">
        <p>See how Lightning Locker restricts DOM access</p>
    </div>
    <lightning:button name="myButton" label="Peek in DOM"
        aura:id="button1" onclick=" {!c.peekInDom} "/>
</aura:component>
```

The `c:domLocker` component creates a `<div>` element and a `lightning:button` component.

Here's the client-side controller that peeks around in the DOM.

```
{/* domLockerController.js */
  peekInDom : function(cmp, event, helper) {
    console.log("cmp.getElements(): ", cmp.getElements());
    // access the DOM in c:domLocker
    console.log("div1: ", cmp.find("div1").getElement());
    console.log("button1: ", cmp.find("button1"));
    console.log("button name: ", event.getSource().get("v.name"));

    // returns an error
    //console.log("button1 element: ", cmp.find("button1").getElement());
  }
})
```

Valid DOM Access

The following methods are valid DOM access because the elements are created by `c:domLocker`.

`cmp.getElements()`

Returns the elements in the DOM rendered by the component.

`cmp.find()`

Returns the div and button components, identified by their `aura:id` attributes.

`cmp.find("div1").getElement()`

Returns the DOM element for the div as `c:domLocker` created the div.

`event.getSource().get("v.name")`

Returns the name of the button that dispatched the event; in this case, `myButton`.

Invalid DOM Access

You can't use `cmp.find("button1").getElement()` to access the DOM element created by `lightning:button`. Lightning Locker doesn't allow `c:domLocker` to access the DOM for `lightning:button` because the button is in the `lightning` namespace and `c:domLocker` is in the `c` namespace.

If you uncomment the code for `cmp.find("button1").getElement()`, you'll see an error:

```
c:domLocker$controller$peekInDom [cmp.find(...).getElement is not a function]
```

IN THIS SECTION:

[How Lightning Locker Uses the Proxy Object](#)

Lightning Locker uses the standard JavaScript `Proxy` object to filter a component's access to underlying JavaScript objects. The `Proxy` object ensures that a component only sees DOM elements created by a component in the same namespace.

SEE ALSO:

[What is Lightning Locker?](#)

[Using JavaScript](#)

How Lightning Locker Uses the `Proxy` Object

Lightning Locker uses the standard JavaScript `Proxy` object to filter a component's access to underlying JavaScript objects. The `Proxy` object ensures that a component only sees DOM elements created by a component in the same namespace.

You can interact with a `Proxy` object in the same way as you interact with the raw JavaScript object, but the object shows up in the browser's console as a `Proxy`. It's useful to understand Lightning Locker's usage of `Proxy` if you drop into your browser's debugger and start poking around.

When a component creates a JavaScript object, Lightning Locker returns the raw JavaScript object. When Lightning Locker filters the object, it returns a `Proxy` object. Some scenarios where Lightning Locker filters an object and returns a `Proxy` object are:

- Passing an object to a component in a different namespace.
- Passing an object from a component on API version less than 40.0 to the method of a component on API version greater than or equal to 40.0.
- Calling `cmp.get()` to retrieve an attribute value that you set with the value of a native JavaScript object or array. The object or array isn't filtered when it's originally created.

When you access these objects, Lightning Locker returns a `Proxy` object.

- Any object that implements the [HTMLCollection](#) interface
- A `SecureElement` object, which represents an HTML element.

For more information about standard JavaScript `Proxy` object, see the [Mozilla Developer Network](#).

SEE ALSO:

[DOM Access Containment](#)

[Secure Wrappers](#)

[Don't Mix Component API Versions](#)

Secure Wrappers

For security, Lightning Locker restricts the use of global objects by hiding an object or by wrapping it in a secure version of the object. For example, the secure version of `window` is `SecureWindow`. Locker intercepts calls to `window` and uses `SecureWindow` instead. Some methods and properties have different behavior or aren't available on the secure objects.

Lightning Locker also replaces instances of other objects, such as components and events, with secure wrapped versions. Here's a list of the most common wrappers that you encounter.

SecureAura

Secure wrapper for `$A`, which is the entry point for using the framework in JavaScript code.

SecureComponent

Secure wrapper for the `Component` object inside the same namespace.

SecureComponentRef

`SecureComponentRef` is a subset of `SecureComponent` that provides the external API for a component in a different namespace.

When you're in a controller or helper, you have access to a `SecureComponent`, essentially the `this` object. If you reference a component in a different namespace, you get a `SecureComponentRef` instead. For example, if your markup includes a `lightning:button` and you call `cmp.find("buttonAuraId")`, you get a `SecureComponentRef` as `lightning:button` is in a different namespace from the component containing the button markup.

SecureDocument

Secure wrapper for the `document` object, which represents the root node of the HTML document or page. The `document` object is the entry point into the page's content, which is the DOM tree.

SecureElement

Secure wrapper for the `Element` object, which represents various HTML elements. `SecureElement` is wrapped in a `Proxy` object as a performance optimization so that its data can be lazily filtered when it's accessed. Therefore, a `Proxy` object represents the HTML element if you're debugging in the browser console.

SecureObject

Secure wrapper for an object that is wrapped by Lightning Locker. When you see a `SecureObject`, it typically means that you don't have access to the underlying object and its properties aren't available.

SecureWindow

Secure wrapper for the `window` object, which represents a window containing a DOM document.

Use the Locker API Viewer to quickly see the difference between the DOM APIs exposed by Lightning Locker versus the standard DOM APIs for the most complex wrappers: `SecureDocument`, `SecureElement`, and `SecureWindow`.

Example

Let's look at a sample component that demonstrates some of the secure wrappers.

```
<!--c:secureWrappers-->
<aura:component>
    <div id="myDiv" aura:id="div1">
        <p>See how Lightning Locker uses secure wrappers</p>
    </div>
    <lightning:button name="myButton" label="Peek in DOM"
        aura:id="button1" onclick="{!!c.peekInDom}"/>
</aura:component>
```

The `c:secureWrappers` component creates a `<div>` HTML element and a `lightning:button` component.

Here's the client-side controller that peeks around in the DOM.

```
({ /* secureWrappersController.js */
    peekInDom : function(cmp, event, helper) {
        console.log("div1: ", cmp.find("div1").getElement());

        console.log("button1: ", cmp.find("button1"));
        console.log("button name: ", event.getSource().get("v.name"));
        // add debugger statement for inspection
        // always remove this from production code
        debugger;
    }
})
```

We use `console.log()` to look at the `<div>` element and the button. The `<div>` `SecureElement` is wrapped in a `Proxy` object as a performance optimization so that its data can be lazily filtered when it's accessed.

We put a debugger statement in the code so that we could inspect the elements in the browser console.

Type these expressions into the browser console and look at the results.

```
cmp
cmp+""
```

```
cmp.find("button1")
cmp.find("button1") + ""
window
window + ""
$A
$A + ""
```

We add an empty string to some expressions so that the object is converted to a `String`. You could also use the `toString()` method.

Here's the output.

```
⋮ | Console
④ top


↵ Proxy {}
  button1: ▶ Object {addValueHandler: function, addValueProvider: function, getGlobalId: function, getLocalId: function, getEvent: function...}
  button name: myButton
  > cmp
  < ▶ Object {get: function, getEvent: function, superRender: function, superAfterRender: function, superRerender: function...}
  > cmp + ""
  < SecureComponent: markup://c:secureWrappers {3:0}{ key: {"namespace": "c"} }
  > cmp.find("button1")
  < ▶ Object {addValueHandler: function, addValueProvider: function, getGlobalId: function, getLocalId: function, getEvent: function...}
  > cmp.find("button1") + ""
  < SecureComponentRef: markup://lightning:button {8:0} {button1}{ key: {"namespace": "c"} }
  > window
  < ▶ Object {document: Function, $A: Object, localStorage: Object, sessionStorage: Object...}
  > window + ""
  < SecureWindow: [object Window]{ key: {"namespace": "c"} }
  > $A
  < ▶ Object {util: Object, LocalizationService: Object, createComponent: function, createComponents: function, enqueueAction: function...}
  > $A + ""
  < SecureAura: [object Object]{ key: {"namespace": "c"} }
  > |


```

Let's examine some of the output.

cmp + ""

Returns a `SecureComponent` object for `cmp`, which represents the `c:secureWrappers` component.

cmp.find("button1") + ""

Returns a `SecureComponentRef`, which represents the external API for a component in a different namespace. In this example, the component is `lightning:button`.

window + ""

Returns a `SecureWindow` object.

\$A + ""

Returns a `SecureAura` object.

SEE ALSO:

[Lightning Locker API Viewer](#)

[How Lightning Locker Uses the Proxy Object](#)

eval() Function is Limited by Lightning Locker

In Lightning Locker, use of the `eval()` function is supported to enable use of third-party libraries that evaluate code dynamically. However, it is limited to work only in the global scope of the namespace. The `eval()` function can't access the local variables within the scope in which it's called.

Normally, `eval()` has two modes of execution. When you invoke `eval()` directly, it works in the local scope. When you invoke it via a reference, it works in the global scope. Lightning Locker only supports the latter.

For example, suppose that you execute the following code:

```
window.foo = 1;
function bar() {
  var foo = 2;
  return eval("foo");
}
```

A call to `bar()` returns 2 when evaluation is performed in the local scope, and returns 1 when it's performed in the global scope. If you must use variables from the local scope, refactor your code. Use a `Function()`, declare the local variables as parameters, pass them as arguments, and add a return statement:

```
window.foo = 1;
function bar() {
  var foo = 2;
  return Function("foo","return foo")(foo);
}
```

MIME Types Permitted

Lightning Locker analyzes the MIME types of files sent through the browser. Locker permits some MIME types, sanitizes some MIME types, and blocks the rest.

These MIME types are allowed, or white-listed, by Lightning Locker.

- `application/octet-stream` — Default value for binary files
- `application/json` — JSON format
- `application/pdf` — Portable Document Format (.pdf)
- `video/*` — All `video/*` mime types
- `audio/*` — All `audio/*` mime types
- `image/*` — All `image/*` mime types
- `font/*` — All `font/*` mime types
- `text/plain` — Text (.txt)
- `text/markdown` — Markdown (.md)
- `application/zip` — Zip archive (.zip)
- `application/x-bzip` — Bzip archive (.bz)
- `application/x-rar-compressed` — RAR archive (.rar)
- `application/x-tar` — Tape archive (.tar)

Locker sanitizes `text/html`, `image/svg+xml`, and `text/xml` MIME types. These types are permitted but Locker removes potentially malicious code.

Any other types are blocked with the error message `Unsupported MIME type`.

If you need to send binary files that are not explicitly permitted, specify the MIME type as `application/octet-stream`.

Access to Supported JavaScript API Framework Methods Only

You can access published, supported JavaScript API framework methods only. These methods are published in the reference doc app at `https://<myDomain>.lightning.force.com/auradocs/reference.app`, where <myDomain> is the name of your custom Salesforce domain. Previously, unsupported methods were accessible, which exposed your code to the risk of breaking when unsupported methods were changed or removed.

What Does Lightning Locker Affect?

Find out what's affected and what's not affected by Lightning Locker.

Lightning Locker enforces security and best practices for custom Lightning components you use in:

- Lightning Experience
- Salesforce app
- Lightning Communities
- Flows
- Standalone apps that you create (for example, `myApp.app`)
- Any other app where you can add a custom Lightning component, such as Salesforce Console in Lightning Experience
- Lightning Out

Lightning Locker doesn't affect the following except for usage of Lightning components in Visualforce in these contexts:

- Salesforce Classic
- Visualforce-based communities
- Any apps for Salesforce Classic, such as Salesforce Console in Salesforce Classic

Lightning Locker Tools

Lightning Locker tools help you develop more secure code that is compatible and runs efficiently with Lightning Locker.

IN THIS SECTION:

[Lightning Locker API Viewer](#)

The Lightning Locker API Viewer shows the DOM APIs exposed by Locker versus the standard DOM APIs for the most complex wrappers: `SecureDocument`, `SecureElement`, and `SecureWindow`.

[Locker Console Overview](#)

Use Locker Console to check your JavaScript code's compatibility with Lightning Locker, and compare how it runs with Lightning Locker enabled and disabled. Access Locker Console in the Component Library.

Lightning Locker API Viewer

The Lightning Locker API Viewer shows the DOM APIs exposed by Locker versus the standard DOM APIs for the most complex wrappers: `SecureDocument`, `SecureElement`, and `SecureWindow`.

Access the API Viewer in the [Component Library](#).

The API Viewer lets you quickly see the difference between the standard DOM APIs and the Locker APIs.

- A **white** row indicates an API that behaves the same in Lightning Locker.
- An **orange** row indicates an API that behaves differently in Lightning Locker.

- A red row means that the API isn't supported in Lightning Locker.

There are several ways to validate your code to ensure compatibility with Aura component APIs. For more information, see [Validations for Aura Component Code](#).

Use the Locker Console to check JavaScript code's compatibility with Lightning Locker.

Reference Doc App

The reference doc app lists the API for `SecureComponent` under [JavaScript API > Component](#).

`SecureAura` is the wrapper for `$A`.

Access the reference doc app at:

<https://<myDomain>.lightning.force.com/auradocs/reference.app>, where `<myDomain>` is the name of your custom Salesforce domain.

SEE ALSO:

[Secure Wrappers](#)

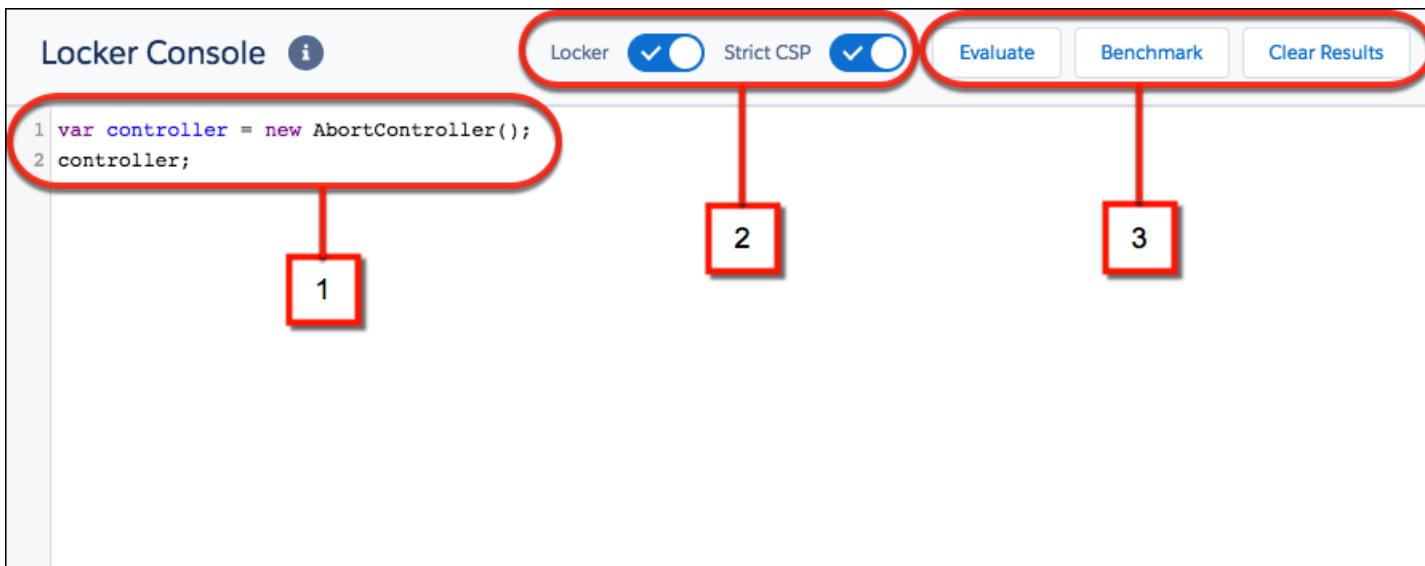
[Locker Console Overview](#)

Locker Console Overview

Use Locker Console to check your JavaScript code's compatibility with Lightning Locker, and compare how it runs with Lightning Locker enabled and disabled. Access Locker Console in the Component Library.

Locker Console enables you to quickly evaluate JavaScript code for issues or benchmark code, without requiring you to create an app to test your component. You can evaluate only JavaScript code in Locker Console. You can't evaluate a complete component bundle or component markup.

Here's an overview of the user interface of the Locker Console tool.



Code Console (1)

Paste or type your JavaScript code here to evaluate or benchmark it.

Toggles (2)

- Enable or disable Locker.
- Enable or disable Strict CSP.

Actions (3)

- Click **Evaluate** to run the code that's displayed in the code console.
- Click **Benchmark** to run your code with and without Lightning Locker and view relative performance metrics.
- Click **Clear Results** to clear all the displayed results.

IN THIS SECTION:

[Evaluate JavaScript Code Compatibility with Lightning Locker](#)

Ensure that your code is compatible with Lightning Locker by running the code with Locker enabled. Run the code a second time with Locker disabled to see if any errors are due to Lightning Locker restrictions.

[Benchmark Lightning Locker Effect on JavaScript Code](#)

Benchmark your JavaScript code with and without Lightning Locker and view relative performance metrics.

SEE ALSO:

[Lightning Locker API Viewer](#)

[Component Library](#)

[Stricter CSP Restrictions](#)

[Evaluate JavaScript Code Compatibility with Lightning Locker](#)

Ensure that your code is compatible with Lightning Locker by running the code with Locker enabled. Run the code a second time with Locker disabled to see if any errors are due to Lightning Locker restrictions.

Let's look at an example that uses a prohibited DOM API.

1. Paste this code into the console.

```
var controller = new AbortController();
controller;
```

2. Click **Evaluate**.

Note the error in the LOCKER ON column of the results window.

```
TypeError: AbortController is not a constructor
```

You get this error because `AbortController` is an experimental interface in the DOM API and is not allowed by Lightning Locker.

The LOCKER OFF column shows – (dash) as this column isn't relevant when the Locker toggle is enabled.

3. Click the **Locker** toggle to disable Lightning Locker.
4. Click **Evaluate** to rerun the code sample with Lightning Locker disabled.

The second row of the results window shows there's no longer an error when Lightning Locker is disabled. The LOCKER OFF column shows `[object AbortController]`, which is the return value of the sample code.

The screenshot shows the Locker Console interface. At the top, there are buttons for 'Locker' (off), 'Strict CSP' (on), 'Evaluate' (highlighted), 'Benchmark', and 'Clear Results'. Below this is a table comparing 'SOURCE CODE' with 'LOCKER OFF' and 'LOCKER ON' results. The 'LOCKER ON' column includes error messages or stack traces.

| SOURCE CODE | LOCKER OFF | LOCKER ON | FAIREST |
|--|------------|--|---------|
| var controller = new AbortController(); controller; | - | TypeError: AbortController is not a constructor - [object AbortController] | - |

Use the Locker API Viewer to see the DOM APIs exposed by Lightning Locker versus the standard DOM APIs for the most complex wrappers: `SecureDocument`, `SecureElement`, and `SecureWindow`.

SEE ALSO:

[Locker Console Overview](#)

[Lightning Locker API Viewer](#)

Benchmark Lightning Locker Effect on JavaScript Code

Benchmark your JavaScript code with and without Lightning Locker and view relative performance metrics.

Benchmarking enables you to see the performance difference with Lightning Locker enabled and disabled, without requiring you to create an app to test your component.

Example

Let's look at an example where you study the performance of a series of nested loops.

- Paste this code into the code console.

```
function build(count) {
    var table = document.createElement("table");
    for (var contact = 0; contact < count; contact++) {
        for(var day = 0; day < 7; day++) {
            var tr = document.createElement("tr");
            var td = document.createElement("td");
            td.textContent = contact;
            tr.appendChild(td);
            for(var hour = 6; hour < 22; hour++) {
                td = document.createElement("td");
                td.className = "officeDivider";
                tr.appendChild(td);

                td = document.createElement("td");
                td.className = "officeHourIn";
                tr.appendChild(td);

                td = document.createElement("td");
                td.className = "officeHourIn";
                tr.appendChild(td);
            }
        }
    }
}
```

```

        td = document.createElement("td");
        td.className = "officeHourIn";
        tr.appendChild(td);

        td = document.createElement("td");
        td.className = "officeHourIn";
        tr.appendChild(td);
    }
    table.appendChild(tr);
}
return table;
};

build(10);

```

2. Click **Benchmark**.

The FASTEST column in the results window shows that the code runs 6.5 times faster when Lightning Locker is disabled. This difference in speed is the cost of security, and whether the performance loss is acceptable depends on each specific case.

| Locker Console ⓘ | | Locker | Strict CSP | Evaluate | Benchmark | Clear Results |
|--|---|-------------------|-------------------|-------------------|-----------|---------------|
| | SOURCE CODE | 🔒 LOCKER OFF | 🔒 LOCKER ON | FAIREST | | |
| 1 function build(count) { 2 var table = document.createElement("table"); 3 for (var contact = 0; contact < count; contact++) { 4 for(var day = 0; day < 7; day++) { 5 var tr = document.createElement("tr"); 6 var td = document.createElement("td"); 7 td.textContent = contact; 8 tr.appendChild(td); 9 for(var hour = 6; hour < 22; hour++) { 10 td = document.createElement("td"); 11 td.className = "officeDivider"; 12 tr.appendChild(td); 13 14 td = document.createElement("td"); 15 td.className = "officeHourIn"; 16 tr.appendChild(td); 17 18 td = document.createElement("td"); 19 td.className = "officeHourIn"; 20 tr.appendChild(td); 21 22 td = document.createElement("td"); 23 td.className = "officeHourIn"; 24 tr.appendChild(td); 25 26 td = document.createElement("td"); 27 td.className = "officeHourIn"; 28 tr.appendChild(td); 29 } 30 table.appendChild(tr); 31 } 32 } 33 return table; 34 }; 35 36 build(10); 37 | function build(count) { var table = document.createElement("table"); for (var contact = 0; contact < count; contact++) { for(var day = 0; day < 7; day++) { var tr = document.createElement("tr"); var td = document.createElement("td"); td.textContent = contact; tr.appendChild(td); for(var hour = 6; hour < 22; hour++) { td = document.createElement("td"); td.className = "officeDivider"; tr.appendChild(td); td = document.createElement("td"); td.className = "officeHourIn"; tr.appendChild(td); td = document.createElement("td"); td.className = "officeHourIn"; tr.appendChild(td); td = document.createElement("td"); td.className = "officeHourIn"; tr.appendChild(td); } table.appendChild(tr); } }; build(10); }; | 109.1 ops/s ±1.9% | 16.8 ops/s ±11.9% | Locker Off 6.50 x | | |

The benchmark action allows you to tweak your code and see how the change affects running time. This rapid iterative process is useful when you're optimizing computationally intensive sections of the code.

Example with Improved Performance

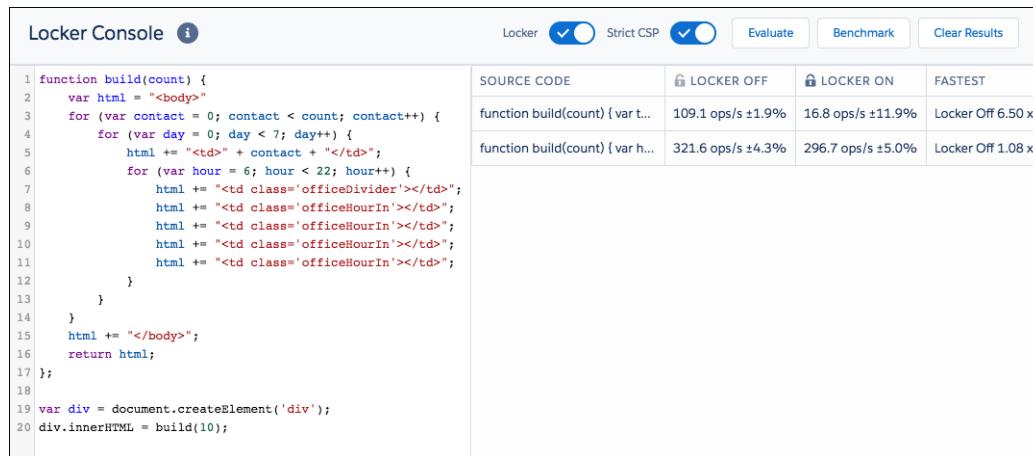
To show how to reduce the overhead of Lightning Locker, let's build the same table using a string of HTML and benchmark to evaluate the difference.

- Paste this code into the code console.

```
function build(count) {
    var html = "<body>"
    for (var contact = 0; contact < count; contact++) {
        for (var day = 0; day < 7; day++) {
            html += "<td>" + contact + "</td>";
            for (var hour = 6; hour < 22; hour++) {
                html += "<td class='officeDivider'></td>";
                html += "<td class='officeHourIn'></td>";
                html += "<td class='officeHourIn'></td>";
                html += "<td class='officeHourIn'></td>";
                html += "<td class='officeHourIn'></td>";
            }
        }
    }
    html += "</body>";
    return html;
};

var div = document.createElement('div');
div.innerHTML = build(10);
```

- Click **Benchmark**.



Because there are no DOM API calls, such as `document.createElement()`, inside the loops in this example, the performance of the `build()` function is similar whether Locker is on or off. The code runs 1.08 times faster when Lightning Locker is disabled, as opposed to 6.5 times faster in the previous example that had multiple DOM API calls.

Plain JavaScript is generally much faster than the DOM API, and the more often a section of code connects to the DOM, the slower the code runs. The DOM API causes most of the Locker overhead. Here, we accelerate the code by reducing the number of times we touch the DOM, which also greatly reduces the overall Locker overhead.

SEE ALSO:

[Locker Console Overview](#)

Disabling Lightning Locker for a Component

You can disable Lightning Locker for a component by setting API version 39.0 or lower for the component. If a component is set to at least API version 40.0, Lightning Locker is enabled. API version 40.0 corresponds to Summer '17, when Lightning Locker was enabled for all orgs.

Lightning Locker is disabled for any component created before Summer '17 because these components have an API version less than 40.0.

Component versioning enables you to associate a component with an API version. When you create a component, the default version is the latest API version. In Developer Console, click **Bundle Version Settings** in the right panel to set the component version.

For consistency and ease of debugging, we recommend that you set the same API version for all components in your app, when possible.

SEE ALSO:

[Don't Mix Component API Versions](#)

[Aura Component Versioning](#)

[Create Aura Components in the Developer Console](#)

Don't Mix Component API Versions

For consistency and ease of debugging, we recommend that you set the same API version for all custom components in your app, containment hierarchy (component within component), or extension hierarchy (component extending component).

If you mix API versions in your containment or extension hierarchy and Lightning Locker is enabled for some components and disabled for other components, your app will be harder to debug.

Extension Hierarchy

Lightning Locker is enabled for a component or an application purely based on component version. The extension hierarchy for a component doesn't factor into Lightning Locker enforcement.

Let's look at an example where a `Car` component extends a `Vehicle` component. `Car` has API version 39.0 so Lightning Locker is disabled. `Vehicle` has API version 40.0 so Lightning Locker is enabled.

Now, let's say that `Vehicle` adds an expando property, `_counter`, to the `window` object by assigning a value to `window._counter`. Since Lightning Locker is enabled for `Vehicle`, the `_counter` property is added to `SecureWindow`, the secure wrapper for `window` for the component's namespace. The property isn't added to the native `window` object.

Lightning Locker is disabled for `Car` so the component has access to the native `window` object. `Car` can't see the `_counter` property as it's only available in the `SecureWindow` object.

This subtle behavior can cause much gnashing of teeth when your code doesn't work as you expect. You'll never get that debugging time back! Save yourself some grief and use the same API version for all components in an extension hierarchy.

Containment Hierarchy

The containment hierarchy within an application or a component doesn't factor into Lightning Locker enforcement.

Let's look at an example where a `Bicycle` component contains a `Wheel` component. If `Bicycle` has API version 40.0, Lightning Locker is enabled. If `Wheel` has API version 39.0, Lightning Locker is disabled for `Wheel` even though it's contained in a component, `Bicycle`, that has Lightning Locker enabled.

Due to the mix of component API versions, you're likely to run into issues similar to those for the extension hierarchy. We recommend that you set the same API version for all components in your app or component hierarchy, when possible.

SEE ALSO:

- [Aura Component Versioning](#)
- [Disabling Lightning Locker for a Component](#)
- [Secure Wrappers](#)
- [Sharing JavaScript Code Across Components](#)

Lightning Locker Disabled for Unsupported Browsers

Lightning Locker relies on some JavaScript features in the browser: support for strict mode, the `Map` object, and the `Proxy` object. If a browser doesn't meet the requirements, Lightning Locker can't enforce all its security features and is disabled.

Lightning Locker is disabled for unsupported browsers. If you use an unsupported browser, you're likely to encounter issues that won't be fixed. Make your life easier and your browsing experience more secure by using a supported browser.



Note: The Lightning Locker requirements align with the supported browsers for Lightning Experience, except for IE11. Lightning Locker is disabled for IE11. We recommend using supported browsers other than IE11 for enhanced security.

SEE ALSO:

- [Browser Support Considerations for Lightning Components](#)
- [Salesforce Help: Supported Browsers for Lightning Experience](#)

Content Security Policy Overview

The Lightning Component framework uses Content Security Policy ([CSP](#)) to impose restrictions on content. The main objective is to help prevent cross-site scripting ([XSS](#)) and other code injection attacks.

[CSP](#) is a W3C standard that defines rules to control the source of content that can be loaded on a page. All CSP rules work at the page level, and apply to all components and libraries.

The framework enables these specific CSP rules:

JavaScript Libraries

All JavaScript libraries must be uploaded to Salesforce static resources. For more information, see [Using External JavaScript Libraries](#) on page 344.

HTTPS Connections for Resources

All external fonts, images, frames, and CSS must use an HTTPS URL.

You can change the CSP policy and expand access to third-party resources by adding CSP Trusted Sites.

Inline JavaScript

Script tags can't be used to load JavaScript, and event handlers can't use inline JavaScript. For more details, see [Stricter CSP Restrictions](#).

Browser Support

CSP isn't enforced by all browsers. For a list of browsers that enforce CSP, see [caniuse.com](#).



Note: IE11 doesn't support CSP, so we recommend using other supported browsers for enhanced security.

Finding CSP Violations

CSP policy violations are logged in the browser's developer console. The violations look like the following message.

```
Refused to load the script 'https://externalsample.com/externalLib.js'  
because it violates the following Content Security Policy directive: ...
```

If your app's functionality isn't affected, you can ignore the CSP violation.

IN THIS SECTION:

[Stricter CSP Restrictions](#)

The Lightning Component framework already uses Content Security Policy (CSP), which is a W3C standard, to control the source of content that can be loaded on a page. The “Enable Stricter Content Security Policy” org setting tightens CSP to further mitigate the risk of cross-site scripting attacks. The CSP rules work at the page level, and apply to all components and libraries, whether Lightning Locker is enabled or not.

SEE ALSO:

[Browser Support Considerations for Lightning Components](#)

[Making API Calls from Components](#)

[Create CSP Trusted Sites to Access Third-Party APIs](#)

[Salesforce Help: Supported Browsers for Lightning Experience](#)

[Salesforce Help: Script Level Security in Communities](#)

Stricter CSP Restrictions

The Lightning Component framework already uses Content Security Policy (CSP), which is a W3C standard, to control the source of content that can be loaded on a page. The “Enable Stricter Content Security Policy” org setting tightens CSP to further mitigate the risk of cross-site scripting attacks. The CSP rules work at the page level, and apply to all components and libraries, whether Lightning Locker is enabled or not.

Stricter CSP disallows `unsafe-inline` for `script-src`. Script tags can't be used to load JavaScript, and event handlers can't use inline JavaScript. For example, this attempt to use an event handler to run an inline script is prevented:

```
<button onclick="doSomething()"></button>
```

When stricter CSP is enabled, you must ensure that all your code, including third-party libraries, respects the stricter CSP restrictions.

What Does Stricter CSP Affect?

Stricter CSP affects:

- Lightning Experience
- Salesforce app
- Standalone apps that you create (for example, `myApp.app`)

Stricter CSP doesn't affect:

- Salesforce Classic
- Any apps for Salesforce Classic, such as Salesforce Console in Salesforce Classic
- Communities
- Lightning Out, which allows you to run Lightning components in a container outside of Lightning apps, such as Lightning components in Visualforce and Visualforce-based Communities. The container defines the CSP rules.

 **Note:** CSP in Communities is controlled separately through each community's settings.

Disable Stricter CSP

Stricter CSP is enabled by default. To disable it:

1. From Setup, enter `Session` in the Quick Find box, and then select **Session Settings**.
2. Deselect the checkbox for "Enable Stricter Content Security Policy".
3. Click **Save**.

Freeze JavaScript Prototypes

Freeze JavaScript prototypes to prevent Aura component authors from modifying JavaScript prototypes of global objects that are shared between namespaces. This restriction enables better code separation between components and prevents malicious or inadvertent tampering of shared objects, such as the JavaScript APIs or DOM APIs.

In JavaScript, each object has a prototype object. An object inherits methods and properties from its prototype object. Prototypes enable a JavaScript object to inherit features from another object. If a component author modifies a JavaScript prototype of a shared object, it can introduce unexpected behavior and potential security issues. Freezing JavaScript prototypes eliminates this risk.

This setting is supported only in Lightning Experience and is disabled by default.

1. From Setup, enter `Session` in the Quick Find box, and then select **Session Settings**.
2. Select the checkbox for "Freeze JavaScript Prototypes".

 **Note:** Cisco Webex Teams and Meetings features aren't compatible with the Freeze JavaScript Prototypes setting. If you have one of these Webex features enabled, you can't enable this setting.

3. Click **Save**.

CHAPTER 9 Using JavaScript

In this chapter ...

- [Invoking Actions on Component Initialization](#)
- [Sharing JavaScript Code in a Component Bundle](#)
- [Sharing JavaScript Code Across Components](#)
- [Using External JavaScript Libraries](#)
- [Dynamically Creating Components](#)
- [Detecting Data Changes with Change Handlers](#)
- [Finding Components by ID](#)
- [Working with Attribute Values in JavaScript](#)
- [Working with a Component Body in JavaScript](#)
- [Working with Events in JavaScript](#)
- [Modifying the DOM](#)
- [Checking Component Validity](#)
- [Modifying Components Outside the Framework Lifecycle](#)
- [Validating Fields](#)
- [Throwing and Handling Errors](#)

Use JavaScript for client-side code. The \$A namespace is the entry point for using the framework in JavaScript code.

For all the methods available in \$A, see the JavaScript API at

<https://<myDomain>.lightning.force.com/auradocs/reference.app>, where <myDomain> is the name of your custom Salesforce domain.

A component bundle can contain JavaScript code in a client-side controller, helper, or renderer. Client-side controllers are the most commonly used of these JavaScript resources.

Expressions in JavaScript Code

In JavaScript, use string syntax to evaluate an expression. For example, this expression retrieves the label attribute in a component.

```
var theLabel = cmp.get("v.label");
```

 **Note:** Only use the { ! } expression syntax in markup in .app or .cmp resources.

SEE ALSO:

[Handling Events with Client-Side Controllers](#)

Using JavaScript

- Calling Component Methods
- Dynamically Adding Event Handlers To a Component
- Dynamically Showing or Hiding Markup
- Adding and Removing Styles
- Which Button Was Pressed?
- Formatting Dates in JavaScript
- Using JavaScript Promises
- Making API Calls from Components
- Create CSP Trusted Sites to Access Third-Party APIs

Invoking Actions on Component Initialization

Use the `init` event to initialize a component or fire an event after component construction but before rendering.

If a component is contained in another component or app, the inner component is initialized first.

Let's look at an example.

Component source

```
<aura:component>
    <aura:attribute name="setMeOnInit" type="String" default="default value" />
    <aura:handler name="init" value="{!this}" action="{!c.doInit}"/>

    <p>This value is set in the controller after the component initializes and before
    rendering.</p>
    <p><b>{ !v.setMeOnInit}</b></p>

</aura:component>
```

Client-side controller source

```
{
    doInit: function(cmp) {
        // Set the attribute value.
        // You could also fire an event here instead.
        cmp.set("v.setMeOnInit", "controller init magic!");
    }
})
```

Let's look at the **Component source** to see how this works. The magic happens in this line.

```
<aura:handler name="init" value="{!this}" action="{!c.doInit}"/>
```

This registers an `init` event handler for the component. `init` is a predefined event sent to every component. After the component is initialized, the `doInit` action is called in the component's controller. In this sample, the controller action sets an attribute value, but it could do something more interesting, such as firing an event.

Setting `value="{ !this }"` marks this as a value event. You should always use this setting for an `init` event.

SEE ALSO:

[Handling Events with Client-Side Controllers](#)

[Create a Custom Renderer](#)

[Component Attributes](#)

[Detecting Data Changes with Change Handlers](#)

Sharing JavaScript Code in a Component Bundle

Put functions that you want to reuse in the component's helper. Helper functions also enable specialization of tasks, such as processing data and firing server-side actions.

A helper function can be called from any JavaScript code in a component's bundle, such as from a client-side controller or renderer.

Helper functions are similar to client-side controller functions in shape, surrounded by parentheses and curly braces to denote a JavaScript object in object-literal notation containing a map of name-value pairs. A helper function can pass in any arguments required by the function, such as the component it belongs to, a callback, or any other objects.

```
{
  helperMethod1 : function() {
    // logic here
  },
  helperMethod2 : function(component) {
    // logic here
    this.helperMethod3(var1, var2);
  },
  helperMethod3 : function(var1, var2) {
    // do something with var1 and var2 here
  }
}
```

To call another function in the same helper, use the syntax: `this.methodName`, where `this` is a reference to the helper itself. For example, `helperMethod2` calls `helperMethod3` with this code.

```
this.helperMethod3(var1, var2);
```

Creating a Helper

A helper resource is part of the component bundle and is auto-wired via the naming convention, `<componentName>Helper.js`.

To create a helper using the Developer Console, click **HELPER** in the sidebar of the component. This helper file is valid for the scope of the component to which it's auto-wired.

Using a Helper in a Controller

Add a `helper` argument to a controller function to enable the function to use the helper. Specify `(component, event, helper)` in the controller. These are standard parameters and you don't have to access them in the function. You can also pass in an instance variable as a parameter, for example, `createExpense: function(component, expense) { ... }`, where `expense` is a variable defined in the component.

The following code shows you how to call the `updateItem` helper function in a controller, which can be used with a custom event handler.

```
/* controller */
({
  newItemEvent: function(component, event, helper) {
    helper.updateItem(component, event.getParam("item"));
  }
})
```

Helper functions are local to a component, improve code reuse, and move the heavy lifting of JavaScript logic away from the client-side controller where possible. The following code shows the helper function, which takes in the `value` parameter set in the controller via

the `item` argument. The code walks through calling a server-side action and returning a callback but you can do something else in the helper function.

```
/* helper */
({
    updateItem : function(component, item, callback) {
        //Update the items via a server-side action
        var action = component.get("c.saveItem");
        action.setParams({"item" : item});
        //Set any optional callback and enqueue the action
        if (callback) {
            action.setCallback(this, callback);
        }
        $A.enqueueAction(action);
    }
})
```

Using a Helper in a Renderer

Add a helper argument to a renderer function to enable the function to use the helper. In the renderer, specify `(component, helper)` as parameters in a function signature to enable the function to access the component's helper. These are standard parameters and you don't have to access them in the function. The following code shows an example on how you can override the `afterRender()` function in the renderer and call `open` in the helper method.

detailsRenderer.js

```
({
    afterRender : function(component, helper){
        helper.open(component, null, "new");
    }
})
```

detailsHelper.js

```
({
    open : function(component, note, mode, sort){
        if(mode === "new") {
            //do something
        }
        // do something else, such as firing an event
    }
})
```

SEE ALSO:

- [Create a Custom Renderer](#)
- [Component Bundles](#)
- [Handling Events with Client-Side Controllers](#)

Sharing JavaScript Code Across Components

You can build simple Lightning components that are entirely self-contained. However, if you build more complex applications, you probably want to share code, or even client-side data, between components.

The `<ltng:require>` tag enables you to load external JavaScript libraries after you upload them as static resources. You can also use `<ltng:require>` to import your own JavaScript libraries of utility methods.

Let's look at a simple counter library that provides a `getValue()` method, which returns the current value of the counter, and an `increment()` method, which increments the value of that counter.

Create the JavaScript Library

1. In the Developer Console, click **File > New > Static Resource**.
2. Enter `counter` in the Name field.
3. Select `text/javascript` in the MIME Type field.
4. Click **Submit**.
5. Enter this code and click **File > Save**.

```
window._counter = (function() {
    var value = 0; // private

    return { //public API
        increment: function() {
            value = value + 1;
            return value;
        },
        getValue: function() {
            return value;
        }
    };
}());
```

This code uses the JavaScript module pattern. Using this closure-based pattern, the `value` variable remains private to your library. Components using the library can't access `value` directly.

The most important line of the code to note is:

```
window._counter = (function() {
```

You must attach `_counter` to the `window` object as a requirement of JavaScript strict mode, which is implicitly enabled in Lightning Locker. Even though `window._counter` looks like a global declaration, `_counter` is attached to the Lightning Locker secure `window` object and therefore is a namespace variable, not a global variable.

If you use `_counter` instead of `window._counter`, `_counter` isn't available. When you try to access it, you get an error similar to:

```
Action failed: ... [_counter is not defined]
```

Use the JavaScript Library

Let's use the library in a `MyCounter` component that has a simple UI to exercise the `counter` methods.

```
<!--c:MyCounter-->
<aura:component access="global">
    <ltng:require scripts=" {!$Resource.counter}"
                  afterScriptsLoaded=" {!c.getValue}"/>
    <aura:attribute name="value" type="Integer"/>

    <h1>MyCounter</h1>
    <p>{!v.value}</p>
    <lightning:button label="Get Value" onclick=" {!c.getValue}"/>
    <lightning:button label="Increment" onclick=" {!c.increment}"/>
</aura:component>
```

The `<ltng:require>` tag loads the counter library and calls the `getValue` action in the component's client-side controller after the library is loaded.

Here's the client-side controller.

```
/* MyCounterController.js */
({
    getValue : function(component, event, helper) {
        component.set("v.value", _counter.getValue());
    },
    increment : function(component, event, helper) {
        component.set("v.value", _counter.increment());
    }
})
```

You can access properties of the `window` object without having to type the `window.` prefix. Therefore, you can use `_counter.getValue()` as shorthand for `window._counter.getValue()`.

Click the buttons to get the value or increment it.

Our counter library shares the counter value between any components that use the library. If you need each component to have a separate counter, you could modify the counter implementation. To see the per-component code and for more details, see this blog post about [Modularizing Code in Lightning Components](#).

SEE ALSO:

- [Using External JavaScript Libraries](#)
- [JavaScript Strict Mode Enforcement](#)

Using External JavaScript Libraries

To reference a JavaScript library that you've uploaded as a static resource, use a `<ltng:require>` tag in your `.cmp` or `.app` markup.

The framework's content security policy mandates that external JavaScript libraries must be uploaded to Salesforce static resources. For more information on static resources, see "Static Resources" in the Salesforce online help.

You can't use a `<script>` tag in a component. This restriction mitigates the risk of cross-site scripting attacks. You can add a `<script>` tag to an application's template, which is a special type of component that extends `aura:template`.

Here's an example of using `<ltng:require>`.

```
<ltng:require scripts="{$Resource.resourceName}"  
    afterScriptsLoaded="{!!c.afterScriptsLoaded}" />
```

`resourceName` is the Name of the static resource. In a managed packaged, the resource name must include the package namespace prefix, such as `$Resource.yourNamespace__resourceName`. For a stand-alone static resource, such as an individual graphic or script, that's all you need. To reference an item within an archive static resource, add the rest of the path to the item using string concatenation.

The `afterScriptsLoaded` action in the client-side controller is called after the scripts are loaded and the component is rendered. Don't use the `init` event to access scripts loaded by `<ltng:require>`. These scripts load asynchronously and are most likely not available when the `init` event handler is called.

Here are some considerations for loading scripts:

Loading Sets of Scripts

Specify a comma-separated list of resources in the `scripts` attribute to load a set of resources.



Note: Due to a quirk in the way `$Resource` is parsed in expressions, use the `join` operator to include multiple `$Resource` references in a single attribute. For example, if you have more than one JavaScript library to include into a component the `scripts` attribute should be something like the following.

```
scripts=" {!join(',',  
    $Resource.jsLibraries + '/jsLibOne.js',  
    $Resource.jsLibraries + '/jsLibTwo.js') }"
```

Loading Order

The scripts are loaded in the order that they are listed.

One-Time Loading

Scripts load only once, even if they're specified in multiple `<ltng:require>` tags in the same component or across different components.

Parallel Loading

Use separate `<ltng:require>` tags for parallel loading if you have multiple sets of scripts that are not dependent on each other.

Encapsulation

To ensure encapsulation and reusability, add the `<ltng:require>` tag to every `.cmp` or `.app` resource that uses the JavaScript library.

`<ltng:require>` also has a `styles` attribute to load a list of CSS resources. You can set the `scripts` and `styles` attributes in one `<ltng:require>` tag.

If you're using an external library to work with your HTML elements after rendering, use `afterScriptsLoaded` to wire up a client-side controller. The following example sets up a chart using the `Chart.js` library, which is uploaded as a static resource.

```
<ltng:require scripts="{$Resource.chart}"  
    afterScriptsLoaded="{!!c.setup}" />  
<canvas aura:id="chart" id="myChart" width="400" height="400"/>
```

The component's client-side controller sets up the chart after component initialization and rendering.

```
setup : function(component, event, helper) {
    var data = {
        labels: ["January", "February", "March"],
        datasets: [
            {
                data: [65, 59, 80, 81, 56, 55, 40]
            }
        ];
    };
    var el = component.find("chart").getElement();
    var ctx = el.getContext("2d");
    var myNewChart = new Chart(ctx).Line(data);
}
```

SEE ALSO:

- [Component Library](#)
- [Content Security Policy Overview](#)
- [Using External CSS](#)
- [\\$Resource](#)
- [Creating App Templates](#)

Dynamically Creating Components

Create a component dynamically in your client-side JavaScript code by using the `$A.createComponent()` method. To create multiple components, use `$A.createComponents()`.

 **Note:** Use `$A.createComponent()` instead of the deprecated `$A.newCmp()` and `$A.newCmpAsync()` methods.

Client-Side Versus Server-Side Component Creation

The `$A.createComponent()` and `$A.createComponents()` methods support both client-side (synchronous) and server-side (asynchronous) component creation. For performance and other reasons, client-side creation is preferred.

To use `$A.createComponent()`, we need the component definition. If we don't have the definition already on the client, the framework makes a server trip to get it. You can avoid this server trip by adding an `<aura:dependency>` tag for the component you're creating in the markup of the component that calls `$A.createComponent()`. The tag ensures that the component definition is always available on the client. The tradeoff is that the definition is always downloaded instead of only when it's needed. This performance tradeoff decision should depend on your use case.

If no server-side dependencies are found, the methods are executed synchronously on the client-side. The top-level component determines whether a server request is necessary for component creation. A component with server-side dependencies must be created on the server. Server-side dependencies include component definitions or dynamically loaded labels that aren't already on the client, and other elements that can't be predetermined by static markup analysis.

 **Note:** A server-side controller isn't a server-side dependency for component creation because controller actions are only called after the component has been created.

A single call to `createComponent()` or `createComponents()` can result in many components being created. The call creates the requested component and all its child components. In addition to performance considerations, server-side component creation has a limit of 10,000 components that can be created in a single request. If you hit this limit, ensure you're explicitly declaring component

dependencies with the `<aura:dependency>` tag or otherwise pre-loading dependent elements, so that your component can be created on the client side instead.

There's no limit on component creation on the client side.

 **Note:** Creating components where the top-level components don't have server dependencies but nested inner components do isn't currently supported.

Syntax

The syntax is:

```
$A.createComponent(String type, Object attributes, function callback)
```

1. `type`—The type of component to create; for example, `"lightning:button"`.
2. `attributes`—A map of attributes for the component, including the local ID (`aura:id`).
3. `callback(cmp, status, errorMessage)`—The callback to invoke after the component is created.

 **Tip:** Component creation is asynchronous if it requires a server trip. You should follow good asynchronous practices, such as only using the new component in the callback.

The callback has three parameters.

- a. `cmp`—The component that was created. This enables you to do something with the new component, such as add it to the body of the component that creates it. If there's an error, `cmp` is `null`.
- b. `status`—The status of the call. The possible values are `SUCCESS`, `INCOMPLETE`, or `ERROR`. Always check that the status is `SUCCESS` before you try to use the component.
- c. `errorMessage`—The error message if the status is `ERROR`.

Example

Let's add a dynamically created button to this sample component.

```
<!--c:createComponent-->
<aura:component>
    <aura:handler name="init" value="{!this}" action=" {!c.doInit}"/>

    <p>Dynamically created button</p>
    { !v.body}
</aura:component>
```

The client-side controller calls `$A.createComponent()` to create a `lightning:button` with a local ID (`aura:id`) and a handler for the `onclick` attribute. The `function(newButton, ...)` callback appends the button to the `body` of `c:createComponent`. The `newButton` that's dynamically created by `$A.createComponent()` is passed as the first argument to the callback.

```
/*createComponentController.js*/
({
    doInit : function(cmp) {
        $A.createComponent(
            "lightning:button",
            {
                "aura:id": "findableAuraId",
```

```

        "label": "Press Me",
        "onclick": cmp.getReference("c.handlePress")
    },
    function(newButton, status, errorMessage) {
        //Add the new button to the body array
        if (status === "SUCCESS") {
            var body = cmp.get("v.body");
            body.push(newButton);
            cmp.set("v.body", body);
        }
        else if (status === "INCOMPLETE") {
            console.log("No response from server or client is offline.")
            // Show offline error
        }
        else if (status === "ERROR") {
            console.log("Error: " + errorMessage);
            // Show error message
        }
    }
);

},
handlePress : function(cmp) {
    // Find the button by the aura:id value
    console.log("button: " + cmp.find("findableAuraId"));
    console.log("button pressed");
}
})
)

```

 **Note:** c:createComponent contains a `{ !v.body }` expression. When you use `cmp.set("v.body", ...)` to set the component body, you must explicitly include `{ !v.body }` in your component markup.

Creating Nested Components

To dynamically create a component in the body of another component, use `$A.createComponents()` to create the components. In the function callback, nest the components by setting the inner component in the `body` of the outer component. This example creates a `ui:outputText` component in the `body` of a `ui:message` component.

```

$A.createComponents([
    ["ui:message", {
        "title" : "Sample Thrown Error",
        "severity" : "error",
    }],
    ["ui:outputText", {
        "value" : e.message
    }]
],
function(components, status, errorMessage) {
    if (status === "SUCCESS") {
        var message = components[0];
        var outputText = components[1];
        // set the body of the ui:message to be the ui:outputText
        message.set("v.body", outputText);
    }
})
)

```

```

        }
        else if (status === "INCOMPLETE") {
            console.log("No response from server or client is offline.")
            // Show offline error
        }
        else if (status === "ERROR") {
            console.log("Error: " + errorMessage);
            // Show error message
        }
    }
);

```

Destroying Dynamically Created Components

After a component that is declared in markup is no longer in use, the framework automatically destroys it and frees up its memory.

If you create a component dynamically in JavaScript and that component isn't added to a facet (`v.body` or another attribute of type `Aura.Component []`), you have to destroy it manually using `Component.destroy()` to avoid memory leaks.

SEE ALSO:

[aura:dependency](#)

[Invoking Actions on Component Initialization](#)

[Dynamically Adding Event Handlers To a Component](#)

Detecting Data Changes with Change Handlers

Configure a component to automatically invoke a change handler, which is a client-side controller action, when a value in one of the component's attributes changes.

When the value changes, the `valueChange.evt` event is automatically fired. The event has `type="VALUE"`.

In the component, define a handler with `name="change"`.

```
<aura:handler name="change" value="{!v.numItems}" action="{!c.itemsChange}" />
```

The `value` attribute sets the component attribute that the change handler tracks.

The `action` attribute sets the client-side controller action to invoke when the attribute value changes.

A component can have multiple `<aura:handler name="change">` tags to detect changes to different attributes.

In the controller, define the action for the handler.

```

({
    itemsChange: function(cmp, evt) {
        console.log("numItems has changed");
        console.log("old value: " + evt.getParam("oldValue"));
        console.log("current value: " + evt.getParam("value"));
    }
})

```

The `valueChange` event gives you access to the previous value (`oldValue`) and the current value (`value`) in the handler action.

When a change occurs to a value that is represented by the `change` handler, the framework handles the firing of the event and rerendering of the component.

SEE ALSO:

[Invoking Actions on Component Initialization](#)

Finding Components by ID

Retrieve a component by its ID in JavaScript code.

Use `aura:id` to add a local ID of `button1` to the `lightning:button` component.

```
<lightning:button aura:id="button1" label="button1"/>
```

You can find the component by calling `cmp.find("button1")`, where `cmp` is a reference to the component containing the button. The `find()` function has one parameter, which is the local ID of a component within the markup.

`find()` returns different types depending on the result.

- If the local ID is unique, `find()` returns the component.
- If there are multiple components with the same local ID, `find()` returns an array of the components.
- If there is no matching local ID, `find()` returns `undefined`.

SEE ALSO:

[Component IDs](#)
[Value Providers](#)

Working with Attribute Values in JavaScript

These common patterns are useful for working with attribute values in JavaScript.

`component.get(String key)` and `component.set(String key, Object value)` retrieves and assigns values associated with the specified key on the component. Keys are passed in as an expression, which represents an attribute value.

To retrieve an attribute value of a component reference, use `component.find("cmpId").get("v.value")`.

Similarly, to set the attribute value of a component reference, use `component.find("cmpId").set("v.value", myValue)`.

This example shows how you can retrieve and set attribute values on a component reference, represented by the button with an ID of `button1`.

```
<aura:component>
    <aura:attribute name="buttonLabel" type="String"/>
    <lightning:button aura:id="button1" label="Button 1"/>
    {!v.buttonLabel}
    <lightning:button label="Get Label" onclick="{!!c.getLabel}"/>
</aura:component>
```

This controller action retrieves the `label` attribute value of a button in a component and sets its value on the `buttonLabel` attribute.

```
({
    getLabel : function(component, event, helper) {
```

```

        var myLabel = component.find("button1").get("v.label");
        component.set("v.buttonLabel", myLabel);
    }
})

```

In the following examples, `cmp` is a reference to a component in your JavaScript code.

Get an Attribute Value

To get the value of a component's `label` attribute:

```
var label = cmp.get("v.label");
```

Set an Attribute Value

To set the value of a component's `label` attribute:

```
cmp.set("v.label", "This is a label");
```

Deep Set an Attribute Value

If an attribute has an object or collection type, such as `Map`, you can deep set properties in the attribute value using the dot notation for expressions. For example, this code sets a value for the `firstName` property in the `user` attribute.

```
component.set("v.user.firstName", "Nina");
```

For deeply nested objects and attributes, continue adding dots to traverse the structure and access the nested values.

Let's look at a component with a `user` attribute of type `Map`.

```

<aura:component>
    <aura:attribute name="user" type="Map"
        default="{
            'id': 99,
            'firstName': 'Eunice',
            'lastName': 'Gomez'}">
    <p>First Name: {!v.user.firstName}</p>
    <lightning:button onclick="!c.deepSet" label="Deep Set" />
</aura:component>

```

When you click the button in the component, you call the `deepSet` action in the client-side controller.

```

({
    deepSet : function(component, event, helper) {
        console.log(component.get("v.user.firstName"));
        component.set("v.user.firstName", "Nina");
        console.log(component.get("v.user.firstName"));
    }
})

```

The `component.set("v.user.firstName", "Nina")` line sets a value for the `firstName` property in the `user` attribute.

Validate That an Attribute Value Is Defined

To determine if a component's `label` attribute is defined:

```
var isDefined = !$A.util.isUndefined(cmp.get("v.label"));
```

Validate That an Attribute Value Is Empty

To determine if a component's `label` attribute is empty:

```
var isEmpty = $A.util.isEmpty(cmp.get("v.label"));
```

SEE ALSO:

[Working with a Component Body in JavaScript](#)

Working with a Component Body in JavaScript

These are useful and common patterns for working with a component's body in JavaScript.

In these examples, `cmp` is a reference to a component in your JavaScript code. It's usually easy to get a reference to a component in JavaScript code. Remember that the `body` attribute is an array of components, so you can use the JavaScript `Array` methods on it.



Note: When you use `cmp.set("v.body", ...)` to set the component body, you must explicitly include `{ !v.body }` in your component markup.

Replace a Component's Body

To replace the current value of a component's body with another component:

```
// newCmp is a reference to another component
cmp.set("v.body", newCmp);
```

Clear a Component's Body

To clear or empty the current value of a component's body:

```
cmp.set("v.body", []);
```

Append a Component to a Component's Body

To append a `newCmp` component to a component's body:

```
var body = cmp.get("v.body");
// newCmp is a reference to another component
body.push(newCmp);
cmp.set("v.body", body);
```

Prepend a Component to a Component's Body

To prepend a `newCmp` component to a component's body:

```
var body = cmp.get("v.body");
body.unshift(newCmp);
cmp.set("v.body", body);
```

Remove a Component from a Component's Body

To remove an indexed entry from a component's body:

```
var body = cmp.get("v.body");
// Index (3) is zero-based so remove the fourth component in the body
body.splice(3, 1);
cmp.set("v.body", body);
```

SEE ALSO:

[Component Body](#)

[Working with Attribute Values in JavaScript](#)

Working with Events in JavaScript

These are useful and common patterns for working with events in JavaScript.

Events communicate data across components. Events can contain attributes with values set before the event is fired and read when the event is handled.

Fire an Event

Fire a component event or an application event that's registered on a component.

```
//Fire a component event
var compEvent = cmp.getEvent("sampleComponentEvent");
compEvent.fire();

//Fire an application event
var appEvent = $A.get("e.c:appEvent");
appEvent.fire();
```

For more information, see:

- [Fire Component Events](#)
- [Fire Application Events](#)

Get an Event Name

To get the name of the event that's fired:

```
event.getSource().getName();
```

Get an Event Parameter

To get an attribute that's passed into an event:

```
event.getParam("value");
```

Get Parameters on an Event

To get all attributes that are passed into an event:

```
event.getParams();
```

`event.getParams()` returns an object containing all event parameters.

Get the Current Phase of an Event

To get the current phase of an event:

```
event.getPhase();
```

If the event hasn't been fired, `event.getPhase()` returns `undefined`. Possible return values for component and application events are `capture`, `bubble`, and `default`. Value events return `default`. For more information, see:

- [Component Event Propagation](#)
- [Application Event Propagation](#)

Get the Source Component

To get the component that fired the event:

```
event.getSource();
```

To retrieve an attribute on the component that fired the event:

```
event.getSource().get("v.myName");
```

Pause the Event

To pause the fired event:

```
event.pause();
```

If paused, the event is not handled until `event.resume()` is called. You can pause an event in the `capture` or `bubble` phase only. For more information, see:

- [Handling Bubbled or Captured Component Events](#)
- [Handling Bubbled or Captured Application Events](#)

Prevent the Default Event Execution

To cancel the default action on the event:

```
event.preventDefault();
```

For example, you can prevent a `lightning:button` component from submitting a form when it's clicked.

Resume a Paused Event

To resume event handling for a paused event:

```
event.resume();
```

You can resume a paused event in the `capture` or `bubble` phase only. For more information, see:

- [Handling Bubbled or Captured Component Events](#)
- [Handling Bubbled or Captured Application Events](#)

Set a Value for an Event Parameter

To set a value for an event parameter:

```
event.setParam("name", cmp.get("v.myName"));
```

If the event has already been fired, setting a parameter value has no effect on the event.

Set Values for Event Parameters

To set values for parameters on an event:

```
event.setParams({  
    key : value  
});
```

If the event has already been fired, setting the parameter values has no effect on the event.

Stop Event Propagation

To prevent further propagation of an event:

```
event.stopPropagation();
```

You can stop event propagation in the `capture` or `bubble` phase only.

Modifying the DOM

The Document Object Model (DOM) is the language-independent model for representing and interacting with objects in HTML and XML documents. It's important to know how to modify the DOM safely so that the framework's rendering service doesn't stomp on your changes and give you unexpected results.

IN THIS SECTION:

[Modifying DOM Elements Managed by the Aura Components Programming Model](#)

The framework creates and manages the DOM elements owned by a component. If you want to modify these DOM elements created by the framework, modify the DOM elements in the handler for the component's `render` event or in a custom renderer. Otherwise, the framework will override your changes when the component is rerendered.

[Modifying DOM Elements Managed by External Libraries](#)

You can use different libraries, such as a charting library, to create and manage DOM elements. You don't have to modify these DOM elements within the `render` event handler or a renderer because they are managed by the external library.

Modifying DOM Elements Managed by the Aura Components Programming Model

The framework creates and manages the DOM elements owned by a component. If you want to modify these DOM elements created by the framework, modify the DOM elements in the handler for the component's `render` event or in a custom renderer. Otherwise, the framework will override your changes when the component is rerendered.

For example, if you modify DOM elements directly from a client-side controller, the changes may be overwritten when the component is rendered.

You can read from the DOM outside a `render` event handler or a custom renderer.

The simplest approach is to leave DOM updates to the framework. Update a component's attribute and use an expression in the markup. The framework's rendering service takes care of the DOM updates.

You can modify CSS classes for a component outside a renderer by using the `$A.util.addClass()`, `$A.util.removeClass()`, and `$A.util.toggleClass()` methods.

There are some use cases where you want to perform post-processing on the DOM or react to rendering or rerendering of a component. For these use cases, there are a few options.

IN THIS SECTION:

[Handle the render Event](#)

When a component is rendered or rerendered, the `aura:valueRender` event, also known as the `render` event, is fired. Handle this event to perform post-processing on the DOM or react to component rendering or rerendering. The event is preferred and easier to use than the alternative of creating a custom renderer.

[Create a Custom Renderer](#)

The framework's rendering service takes in-memory component state and creates and manages the DOM elements owned by the component. If you want to modify DOM elements created by the framework for a component, you can modify the DOM elements in the component's renderer. Otherwise, the framework will override your changes when the component is rerendered.

SEE ALSO:

[Modifying DOM Elements Managed by External Libraries](#)

[Using Expressions](#)

[Dynamically Showing or Hiding Markup](#)

Handle the `render` Event

When a component is rendered or rerendered, the `aura:valueRender` event, also known as the `render` event, is fired. Handle this event to perform post-processing on the DOM or react to component rendering or rerendering. The event is preferred and easier to use than the alternative of creating a custom renderer.

The `render` event is fired after all methods in a custom renderer are invoked. For more details on the sequence in the rendering or rerendering lifecycles, see [Create a Custom Renderer](#).

Handling the `aura:valueRender` event is similar to handling the `init` hook. Add a handler to your component's markup.

```
<aura:handler name="render" value="{!this}" action="{!!c.onRender}"/>
```

In this example, the `onRender` action in your client-side controller handles initial rendering and rerendering of the component. You can choose any name for the `action` attribute.

SEE ALSO:

[Invoking Actions on Component Initialization](#)

[Create a Custom Renderer](#)

Create a Custom Renderer

The framework's rendering service takes in-memory component state and creates and manages the DOM elements owned by the component. If you want to modify DOM elements created by the framework for a component, you can modify the DOM elements in the component's renderer. Otherwise, the framework will override your changes when the component is rerendered.

The DOM is the language-independent model for representing and interacting with objects in HTML and XML documents. The framework automatically renders your components so you don't have to know anything more about rendering unless you need to customize the default rendering behavior for a component.

 **Note:** It's preferred and easier to [handle the `render` event](#) rather than the alternative of creating a custom renderer.

Base Component Rendering

The base component in the framework is `aura:component`. Every component extends this base component.

The renderer for `aura:component` is in `componentRenderer.js`. This renderer has base implementations for the four phases of the rendering and rerendering cycles:

- `render()`
- `rerender()`
- `afterRender()`
- `unrender()`

The framework calls these functions as part of the rendering and rerendering lifecycles and we will learn more about them soon. You can override the base rendering functions in a custom renderer.

Rendering Lifecycle

The rendering lifecycle happens once in the lifetime of a component unless the component gets explicitly unrendered. When you create a component:

1. The framework fires an `init` event, enabling you to update a component or fire an event after component construction but before rendering.
2. The `render()` method is called to render the component's body.
3. The `afterRender()` method is called to enable you to interact with the DOM tree after the framework's rendering service has inserted DOM elements.
4. The framework fires a `render` event, enabling you to interact with the DOM tree after the framework's rendering service has inserted DOM elements. Handling the `render` event is preferred to creating a custom renderer and overriding `afterRender()`.

Rerendering Lifecycle

The rerendering lifecycle automatically handles rerendering of components whenever the underlying data changes. Here is a typical sequence.

1. A browser event triggers one or more Lightning events.
2. Each Lightning event triggers one or more actions that can update data. The updated data can fire more events.
3. The rendering service tracks the stack of events that are fired.
4. The framework rerenders all the components that own modified data by calling each component's `rerender()` method.
5. The framework fires a `render` event, enabling you to interact with the DOM tree after the framework rerenders a component. Handling the `render` event is preferred to creating a custom renderer and overriding `rerender()`.

The component rerendering lifecycle repeats whenever the underlying data changes as long as the component is valid and not explicitly unrendered.

For more information, see [Events Fired During the Rendering Lifecycle](#).

Custom Renderer

You don't normally have to write a custom renderer, but it's useful when you want to interact with the DOM tree after the framework's rendering service has inserted DOM elements. If you want to customize rendering behavior and you can't do it in markup or by using the `init` event, you can create a client-side renderer.

A renderer file is part of the component bundle and is auto-wired if you follow the naming convention, `<componentName>Renderer.js`. For example, the renderer for `sample.cmp` would be in `sampleRenderer.js`.



Note: These guidelines are important when you customize rendering.

- Only modify DOM elements that are part of the component. Never break component encapsulation by reaching in to another component and changing its DOM elements, even if you are reaching in from the parent component.
- Never fire an event as it can trigger new rendering cycles. An alternative is to use an `init` event instead.
- Don't set attribute values on other components as these changes can trigger new rendering cycles.
- Move as much of the UI concerns, including positioning, to CSS.

Customize Component Rendering

Customize rendering by creating a `render()` function in your component's renderer to override the base `render()` function, which updates the DOM.

The `render()` function returns a DOM node, an array of DOM nodes, or nothing. The base HTML component expects DOM nodes when it renders a component.

You generally want to extend default rendering by calling `superRender()` from your `render()` function before you add your custom rendering code. Calling `superRender()` creates the DOM nodes specified in the markup.

This code outlines a custom `render()` function.

```
render : function(cmp, helper) {
    var ret = this.superRender();
    // do custom rendering here
    return ret;
},
```

Rerender Components

When an event is fired, it may trigger actions to change data and call `rerender()` on affected components. The `rerender()` function enables components to update themselves based on updates to other components since they were last rendered. This function doesn't return a value.

If you update data in a component, the framework automatically calls `rerender()`.

You generally want to extend default rerendering by calling `superRerender()` from your `renderer()` function before you add your custom rerendering code. Calling `superRerender()` chains the rerendering to the components in the `body` attribute.

This code outlines a custom `rerender()` function.

```
rerender : function(cmp, helper) {
    this.superRerender();
    // do custom rerendering here
}
```

Access the DOM After Rendering

The `afterRender()` function enables you to interact with the DOM tree after the framework's rendering service has inserted DOM elements. It's not necessarily the final call in the rendering lifecycle; it's simply called after `render()` and it doesn't return a value.

You generally want to extend default after rendering by calling `superAfterRender()` function before you add your custom code.

This code outlines a custom `afterRender()` function.

```
afterRender: function (component, helper) {
    this.superAfterRender();
    // interact with the DOM here
},
```

Unrender Components

The base `unrender()` function deletes all the DOM nodes rendered by a component's `render()` function. It is called by the framework when a component is being destroyed. Customize this behavior by overriding `unrender()` in your component's renderer. This method can be useful when you are working with third-party libraries that are not native to the framework.

You generally want to extend default unrendering by calling `superUnrender()` from your `unrender()` function before you add your custom code.

This code outlines a custom `unrender()` function.

```
unrender: function () {
    this.superUnrender();
    // do custom unrendering here
}
```

SEE ALSO:

[Modifying the DOM](#)

[Invoking Actions on Component Initialization](#)

[Component Bundles](#)

[Modifying Components Outside the Framework Lifecycle](#)

[Sharing JavaScript Code in a Component Bundle](#)

Modifying DOM Elements Managed by External Libraries

You can use different libraries, such as a charting library, to create and manage DOM elements. You don't have to modify these DOM elements within the `render` event handler or a renderer because they are managed by the external library.

A `render` event handler or a renderer are used only to customize DOM elements created and managed by the Aura Components programming model.

To use external libraries, use `<ltng:require>`. The `afterScriptsLoaded` attribute enables you to interact with the DOM after your libraries have loaded and the DOM is ready. `<ltng:require>` tag orchestrates the loading of your library of choice with the rendering cycle of the Aura Components programming model to ensure that everything works in concert.

SEE ALSO:

[Using External JavaScript Libraries](#)

[Modifying DOM Elements Managed by the Aura Components Programming Model](#)

Checking Component Validity

If you navigate elsewhere in the UI while asynchronous code is executing, the framework unrenders and destroys the component that made the asynchronous request. You can still have a reference to that component, but it is no longer valid. The `cmp.isValid()` call returns `false` for an invalid component.

If you call `cmp.get()` on an invalid component, `cmp.get()` returns `null`.

If you call `cmp.set()` on an invalid component, nothing happens and no error occurs. It's essentially a no op.

In many scenarios, the `cmp.isValid()` call isn't necessary because a `null` check on a value retrieved from `cmp.get()` is sufficient. The main reason to call `cmp.isValid()` is if you're making multiple calls against the component and you want to avoid a `null` check for each result.

Inside the Framework Lifecycle

You don't need a `cmp.isValid()` check in the callback in a client-side controller when you reference the component associated with the client-side controller. The framework automatically checks that the component is valid. Similarly, you don't need a `cmp.isValid()` check during event handling or in a framework lifecycle hook, such as the `init` event.

Let's look at a sample client-side controller.

```
({
    "doSomething" : function(cmp) {
        var action = cmp.get("c.serverEcho");
        action.setCallback(this, function(response) {
            var state = response.getState();
            if (state === "SUCCESS") {
                if (cmp.get("v.displayResult")) {
                    alert("From server: " + response.getReturnValue());
                }
            }
            // other state handling omitted for brevity
        });
        $A.enqueueAction(action);
    }
});
```

```
    }
})
```

The component wired to the client-side controller is passed into the `doSomething` action as the `cmp` parameter. When `cmp.get("v.displayResult")` is called, we don't need a `cmp.isValid()` check.

However, if you hold a reference to another component that may not be valid despite your component being valid, you might need a `cmp.isValid()` check for the other component. Let's look at another example of a component that has a reference to another component with a local ID of `child`.

```
(({
    "doSomething" : function(cmp) {
        var action = cmp.get("c.serverEcho");
        var child = cmp.find("child");
        action.setCallback(this, function(response) {
            var state = response.getState();
            if (state === "SUCCESS") {
                if (child.get("v.displayResult")) {
                    alert("From server: " + response.getReturnValue());
                }
            }
            // other state handling omitted for brevity
        });
        $A.enqueueAction(action);
    }
}))
```

This line in the previous example without the child component:

```
if (cmp.get("v.displayResult")) {
```

changed to:

```
if (child.get("v.displayResult")) {
```

You don't need a `child.isValid()` call here as `child.get("v.displayResult")` will return `null` if the child component is invalid. Add a `child.isValid()` check only if you're making multiple calls against the child component and you want to avoid a `null` check for each result.

Outside the Framework Lifecycle

If you reference a component in asynchronous code, such as `setTimeout()` or `setInterval()`, or when you use Promises, a `cmp.isValid()` call checks that the component is still valid before processing the results of the asynchronous request. In many scenarios, the `cmp.isValid()` call isn't necessary because a `null` check on a value retrieved from `cmp.get()` is sufficient. The main reason to call `cmp.isValid()` is if you're making multiple calls against the component and you want to avoid a `null` check for each result.

For example, you don't need a `cmp.isValid()` check within this `setTimeout()` call as the `cmp.set()` call doesn't do anything when the component is invalid.

```
window.setTimeout(
    $A.getCallback(function() {
        cmp.set("v.visible", true);
```

```
    }), 5000  
);
```

SEE ALSO:

- [Handling Events with Client-Side Controllers](#)
- [Invoking Actions on Component Initialization](#)
- [Modifying Components Outside the Framework Lifecycle](#)

Modifying Components Outside the Framework Lifecycle

Use `$A.getCallback()` to wrap any code that modifies a component outside the normal rerendering lifecycle, such as in a `setTimeout()` call. The `$A.getCallback()` call ensures that the framework rerenders the modified component and processes any enqueued actions.

 **Note:** `$A.run()` is deprecated. Use `$A.getCallback()` instead.

You don't need to use `$A.getCallback()` if your code is executed as part of the framework's call stack; for example, your code is handling an event or in the callback for a server-side controller action. An exception is when you want to pass the callback to Lightning Data Service, such as when you are creating a record using `force:recordData`. If the callback is passed in without being wrapped in `$A.getCallback()`, any attempt to access private attributes of your component results in access check failures.

An example of where you need to use `$A.getCallback()` is calling `window.setTimeout()` in an event handler to execute some logic after a time delay. This puts your code outside the framework's call stack.

This sample sets the `visible` attribute on a component to `true` after a five-second delay.

```
window.setTimeout(  
    $A.getCallback(function() {  
        cmp.set("v.visible", true);  
    }), 5000  
);
```

Note how the code updating a component attribute is wrapped in `$A.getCallback()`, which ensures that the framework rerenders the modified component.

 **Note:** You don't need a `cmp.isValid()` check within this `setTimeout()` call as the `cmp.set()` call doesn't do anything when the component is invalid.

 **Warning:** Don't save a reference to a function wrapped in `$A.getCallback()`. If you use the reference later to send actions, the saved transaction state will cause the actions to be aborted.

SEE ALSO:

- [Creating a Record](#)
- [Handling Events with Client-Side Controllers](#)
- [Checking Component Validity](#)
- [Firing Lightning Events from Non-Lightning Code](#)
- [Communicating with Events](#)

Validating Fields

Validate user input, handle errors, and display error messages on input fields.

Client-side input validation is available for the following components:

- `lightning:input`
- `lightning:select`
- `lightning:textarea`
- `ui:input*`

Components in the `lightning` namespace simplify input validation by providing attributes to define error conditions, enabling you to handle errors by checking the component's validity state. For example, you can set a minimum length for a field, display an error message when the condition is not met, and handle the error based on the given validity state. For more information, see the `lightning` namespace components in the <https://developer.salesforce.com/docs/component-library>.

Alternatively, input components in the `ui` namespace let you define and handle errors in a client-side controller, enabling you to iterate through a list of errors.

The following sections discuss error handling for `ui:input*` components.

Default Error Handling

The framework can handle and display errors using the default error component, `ui:inputDefaultError`. This component is dynamically created when you set the errors using the `inputCmp.set("v.errors", [{message:"my error message"}])` syntax. The following example shows how you can handle a validation error and display an error message. Here is the markup.

```
<!--c:errorHandling-->
<aura:component>
    Enter a number: <ui:inputNumber aura:id="inputCmp"/> <br/>
    <lightning:button label="Submit" onclick="{!!c.doAction}"/>
</aura:component>
```

Here is the client-side controller.

```
/*errorHandlingController.js*/
{
    doAction : function(component) {
        var inputCmp = component.find("inputCmp");
        var value = inputCmp.get("v.value");

        // Is input numeric?
        if (isNaN(value)) {
            // Set error
            inputCmp.set("v.errors", [{message:"Input not a number: " + value}]);
        } else {
            // Clear error
            inputCmp.set("v.errors", null);
        }
    }
}
```

When you enter a value and click **Submit**, `doAction` in the controller validates the input and displays an error message if the input is not a number. Entering a valid input clears the error. Add error messages to the input component using the `errors` attribute.

Custom Error Handling

`ui:input` and its child components can handle errors using the `onError` and `onClearErrors` events, which are wired to your custom error handlers defined in a controller. `onError` maps to a `ui:validationError` event, and `onClearErrors` maps to `ui:clearErrors`.

The following example shows how you can handle a validation error using custom error handlers and display the error message using the default error component. Here is the markup.

```
<!--c:errorHandlingCustom-->
<aura:component>
    Enter a number: <ui:inputNumber aura:id="inputCmp" onError="{!!c.handleError}"
    onClearErrors="{!!c.handleClearError}" /> <br/>
    <ui:button label="Submit" press="{!!c.doAction}" />
</aura:component>
```

Here is the client-side controller.

```
/*errorHandlingCustomController.js*/
{
    doAction : function(component, event) {
        var inputCmp = component.find("inputCmp");
        var value = inputCmp.get("v.value");

        // is input numeric?
        if (isNaN(value)) {
            inputCmp.set("v.errors", [{message:"Input not a number: " + value}]);
        } else {
            inputCmp.set("v.errors", null);
        }
    },

    handleError: function(component, event) {
        /* do any custom error handling
         * logic desired here */
        // get v.errors, which is an Object[]
        var errorsArr = event.getParam("errors");
        for (var i = 0; i < errorsArr.length; i++) {
            console.log("error " + i + ": " + JSON.stringify(errorsArr[i]));
        }
    },

    handleClearError: function(component, event) {
        /* do any custom error handling
         * logic desired here */
    }
}
```

When you enter a value and click **Submit**, `doAction` in the controller executes. However, instead of letting the framework handle the errors, we define a custom error handler using the `onError` event in `<ui:inputNumber>`. If the validation fails, `doAction` adds an error message using the `errors` attribute. This automatically fires the `handleError` custom error handler.

Similarly, you can customize clearing the errors by using the `onClearErrors` event. See the `handleClearError` handler in the controller for an example.

SEE ALSO:

[Handling Events with Client-Side Controllers](#)

[Component Events](#)

Throwing and Handling Errors

The framework gives you flexibility in handling unrecoverable and recoverable app errors in JavaScript code. For example, you can throw these errors in a callback when handling an error in a server-side response.

Unrecoverable Errors

Use `throw new Error("error message here")` for unrecoverable errors, such as an error that prevents your app from starting successfully. The error message is displayed.



Note: `$A.error()` is deprecated. Throw the native JavaScript `Error` object instead by using `throw new Error()`.

This example shows you the basics of throwing an unrecoverable error in a JavaScript controller.

```
<!--c:unrecoverableError-->
<aura:component>
    <lightning:button label="throw error" onclick="{!!c.throwError}"/>
</aura:component>
```

Here is the client-side controller source.

```
/*unrecoverableErrorController.js*/
({
    throwError : function(component, event) {
        throw new Error("I can't go on. This is the end.");
    }
})
```

Recoverable Errors

To handle recoverable errors, use a component, such as `ui:message`, to tell users about the problem.

This sample shows you the basics of throwing and catching a recoverable error in a JavaScript controller.

```
<!--c:recoverableError-->
<aura:component>
    <p>Click the button to trigger the controller to throw an error.</p>
    <div aura:id="div1"></div>

    <lightning:button label="Throw an Error" onclick="{!!c.throwErrorForKicks}"/>
</aura:component>
```

Here is the client-side controller source.

```
/*recoverableErrorController.js*/
({
    throwErrorForKicks: function(cmp) {
        // this sample always throws an error to demo try/catch
        var hasPerm = false;
        try {
            if (!hasPerm) {
                throw new Error("You don't have permission to edit this record.");
            }
        }
        catch (e) {
            $A.createComponents([
                ["ui:message", {
                    "title" : "Sample Thrown Error",
                    "severity" : "error",
                }],
                ["ui:outputText", {
                    "value" : e.message
                }]
            ],
            function(components, status, errorMessage) {
                if (status === "SUCCESS") {
                    var message = components[0];
                    var outputText = components[1];
                    // set the body of the ui:message to be the ui:outputText
                    message.set("v.body", outputText);
                    var div1 = cmp.find("div1");
                    // Replace div body with the dynamic component
                    div1.set("v.body", message);
                }
                else if (status === "INCOMPLETE") {
                    console.log("No response from server or client is offline.")
                    // Show offline error
                }
                else if (status === "ERROR") {
                    console.log("Error: " + errorMessage);
                    // Show error message
                }
            }
        );
    }
})
});
```

The controller code always throws an error and catches it in this example. The message in the error is displayed to the user in a dynamically created `ui:message` component. The body of the `ui:message` is a `ui:outputText` component containing the error text.

SEE ALSO:

[Validating Fields](#)

[Dynamically Creating Components](#)

Calling Component Methods

Use `<aura:method>` to define a method as part of a component's API. This enables you to directly call a method in a component's client-side controller instead of firing and handling a component event. Using `<aura:method>` simplifies the code needed for a parent component to call a method on a child component that it contains.

Communicate Between Components

Use `aura:method` to communicate down the containment hierarchy. For example, a parent component calls an `aura:method` on a child component that it contains.

To communicate up the containment hierarchy, fire a component event in the child component and handle it in the parent component.

Syntax

Use this syntax to call a method in JavaScript code.

```
cmp.sampleMethod(arg1, ... argN);
```

`cmp` is a reference to the component.

`sampleMethod` is the name of the `aura:method`.

`arg1, ... argN` is an optional comma-separated list of arguments passed to the method. Each argument corresponds to an `aura:attribute` defined in the `aura:method` markup.

Using Inherited Methods

A sub component that extends a super component has access to any methods defined in the super component.

An interface can also include an `<aura:method>` tag. A component that implements the interface can access the method.

Example

Let's look at an example app.

```
<!-- c:auraMethodCallerWrapper.app -->
<aura:application>
    <c:auraMethodCaller />
</aura:application>
```

`c:auraMethodCallerWrapper.app` contains a `c:auraMethodCaller` component.

```
<!-- c:auraMethodCaller.cmp -->
<aura:component>
    <p>Parent component calls aura:method in child component</p>
    <c:auraMethod aura:id="child" />

    ...
</aura:component>
```

`c:auraMethodCaller` is the parent component. `c:auraMethodCaller` contains the child component, `c:auraMethod`.

We'll show how `c:auraMethodCaller` calls an `aura:method` defined in `c:auraMethod`.

We'll use `c:auraMethodCallerWrapper.app` to see how to return results from synchronous and asynchronous code.

IN THIS SECTION:

[Return Result for Synchronous Code](#)

`aura:method` executes synchronously. A synchronous method finishes executing before it returns. Use the `return` statement to return a value from synchronous JavaScript code.

[Return Result for Asynchronous Code](#)

`aura:method` executes synchronously. Use the `return` statement to return a value from synchronous JavaScript code. JavaScript code that calls a server-side action is asynchronous. Asynchronous code can continue to execute after it returns. You can't use the `return` statement to return the result of an asynchronous call because the `aura:method` returns before the asynchronous code completes. For asynchronous code, use a callback instead of a `return` statement.

SEE ALSO:

[aura:method](#)

[Component Events](#)

Return Result for Synchronous Code

`aura:method` executes synchronously. A synchronous method finishes executing before it returns. Use the `return` statement to return a value from synchronous JavaScript code.

An asynchronous method can continue to execute after it returns. JavaScript code often uses the callback pattern to return a result after asynchronous code completes. We'll describe later how to return a result for an asynchronous action.

Step 1: Define `aura:method` in Markup

Let's look at a `logParam` `aura:method` that executes synchronous code. We'll use the `c:auraMethodCallerWrapper.app` and components outlined in [Calling Component Methods](#). Here's the markup that defines the `aura:method`.

```
<!-- c:auraMethod -->
<aura:component>
    <aura:method name="logParam"
        description="Sample method with parameter">
        <aura:attribute name="message" type="String" default="default message" />
    </aura:method>

    <p>This component has an aura:method definition.</p>
</aura:component>
```

The `logParam` `aura:method` has an `aura:attribute` with a name of `message`. This attribute enables you to set a `message` parameter when you call the `logParam` method.

The name attribute of `logParam` configures the `aura:method` to invoke `logParam()` in the client-side controller.

An `aura:method` can have multiple `aura:attribute` tags. Each `aura:attribute` corresponds to a parameter that you can pass into the `aura:method`. For more details on the syntax, see [aura:method](#).

You don't explicitly declare a return value in the `aura:method` markup. You just use a `return` statement in the JavaScript controller.

Step 2: Implement `aura:method` Logic in Controller

The `logParam` `aura:method` invokes `logParam()` in `auraMethodController.js`. Let's look at that source.

```
/* auraMethodController.js */
({
  logParam : function(cmp, event) {
    var params = event.getParam('arguments');
    if (params) {
      var message = params.message;
      console.log("message: " + message);
      return message;
    }
  },
})
```

`logParam()` simply logs the parameter passed in and returns the parameter value to demonstrate how to use the `return` statement. If your code is synchronous, you can use a `return` statement; for example, you're not making an asynchronous server-side action call.

Step 3: Call `aura:method` from Parent Controller

`callAuraMethod()` in the controller for `c:auraMethodCaller` calls the `logParam` `aura:method` defined in its child component, `c:auraMethod`. Here's the controller for `c:auraMethodCaller`.

```
/* auraMethodCallerController.js */
({
  callAuraMethod : function(component, event, helper) {
    var childCmp = component.find("child");
    // call the aura:method in the child component
    var auraMethodResult =
      childCmp.logParam("message sent by parent component");
    console.log("auraMethodResult: " + auraMethodResult);
  },
})
```

`callAuraMethod()` finds the child component, `c:auraMethod`, and calls its `logParam` `aura:method` with an argument for the `message` parameter of the `aura:method`.

```
childCmp.logParam("message sent by parent component");
```

`auraMethodResult` is the value returned from `logParam`.

Step 4: Add Button to Initiate Call to `aura:method`

The `c:auraMethodCaller` markup contains a `lightning:button` that invokes `callAuraMethod()` in `auraMethodCallerController.js`. We use this button to initiate the call to `aura:method` in the child component.

```
<!-- c:auraMethodCaller.cmp -->
<aura:component>
  <p>Parent component calls aura:method in child component</p>
  <c:auraMethod aura:id="child" />

  <lightning:button label="Call aura:method in child component"
```

```
<aura:component>
    <a href="#" onclick=" {! c.callAuraMethod } " />
</aura:component>
```

SEE ALSO:

[Return Result for Asynchronous Code](#)[Calling Component Methods](#)[aura:method](#)

Return Result for Asynchronous Code

`aura:method` executes synchronously. Use the `return` statement to return a value from synchronous JavaScript code. JavaScript code that calls a server-side action is asynchronous. Asynchronous code can continue to execute after it returns. You can't use the `return` statement to return the result of an asynchronous call because the `aura:method` returns before the asynchronous code completes. For asynchronous code, use a callback instead of a `return` statement.

Step 1: Define `aura:method` in Markup

Let's look at an echo `aura:method` that uses a callback. We'll use the `c:auraMethodCallerWrapper.app` and components outlined in [Calling Component Methods](#). Here's the echo `aura:method` in the `c:auraMethod` component.

```
<!-- c:auraMethod -->
<aura:component controller="SimpleServerSideController">
    <aura:method name="echo"
        description="Sample method with server-side call">
        <aura:attribute name="callback" type="Function" />
    </aura:method>

    <p>This component has an aura:method definition.</p>
</aura:component>
```

The echo `aura:method` has an `aura:attribute` with a name of `callback`. This attribute enables you to set a callback that's invoked by the `aura:method` after execution of the server-side action in `SimpleServerSideController`.

Step 2: Implement `aura:method` Logic in Controller

The echo `aura:method` invokes `echo()` in `auraMethodController.js`. Let's look at the source.

```
/* auraMethodController.js */
({
    echo : function(cmp, event) {
        var params = event.getParam('arguments');
        var callback;
        if (params) {
            callback = params.callback;
        }

        var action = cmp.get("c.serverEcho");
        action.setCallback(this, function(response) {
            var state = response.getState();
            if (state === "SUCCESS") {
```

```

        console.log("From server: " + response.getReturnValue());
        // return doesn't work for async server action call
        //return response.getReturnValue();
        // call the callback passed into aura:method
        if (callback) callback(response.getReturnValue());
    }
    else if (state === "INCOMPLETE") {
        // do something
    }
    else if (state === "ERROR") {
        var errors = response.getError();
        if (errors) {
            if (errors[0] && errors[0].message) {
                console.log("Error message: " +
                    errors[0].message);
            }
        } else {
            console.log("Unknown error");
        }
    }
});
$A.enqueueAction(action);
},
})
)

```

`echo()` calls the `serverEcho()` server-side controller action, which we'll create next.

- (i) **Note:** You can't return the result with a `return` statement. The `aura:method` returns before the asynchronous server-side action call completes. Instead, we invoke the callback passed into the `aura:method` and set the result as a parameter in the callback.

Step 3: Create Apex Server-Side Controller

The `echo` `aura:method` calls a server-side controller action called `serverEcho`. Here's the source for the server-side controller.

```

public with sharing class SimpleServerSideController {
    @AuraEnabled
    public static String serverEcho() {
        return ('Hello from the server');
    }
}

```

The `serverEcho()` method returns a `String`.

Step 4: Call `aura:method` from Parent Controller

Here's the controller for `c:auraMethodCaller`. It calls the `echo` `aura:method` in its child component, `c:auraMethod`.

```

/* auraMethodCallerController.js */
({
    callAuraMethodServerTrip : function(component, event, helper) {
        var childCmp = component.find("child");
        // call the aura:method in the child component
        childCmp.echo(function(result) {

```

```

        console.log("callback for aura:method was executed");
        console.log("result: " + result);
    });
},
})

```

`callAuraMethodServerTrip()` finds the child component, `c:auraMethod`, and calls its `echo` `aura:method.echo()`. It passes a callback function into the `aura:method`.

The callback configured in `auraMethodCallerController.js` logs the result.

```

function(result) {
    console.log("callback for aura:method was executed");
    console.log("result: " + result);
}

```

Step 5: Add Button to Initiate Call to `aura:method`

The `c:auraMethodCaller` markup contains a `lightning:button` that invokes `callAuraMethodServerTrip()` in `auraMethodCallerController.js`. We use this button to initiate the call to the `aura:method` in the child component.

Here's the markup for `c:auraMethodCaller`.

```

<!-- c:auraMethodCaller.cmp -->
<aura:component>
    <p>Parent component calls aura:method in child component</p>
    <c:auraMethod aura:id="child" />

    <lightning:button label="Call aura:method (server trip) in child component"
        onclick="{!! c.callAuraMethodServerTrip()}" />
</aura:component>

```

SEE ALSO:

- [Return Result for Synchronous Code](#)
- [Calling Component Methods](#)
- [aura:method](#)

Dynamically Adding Event Handlers To a Component

You can dynamically add a handler for an event that a component fires.

The `addEventHandler()` method in the `Component` object replaces the deprecated `addHandler()` method.

To add an event handler to a component dynamically, use the `addEventHandler()` method.

```
addEventHandler(String event, Function handler, String phase, String includeFacets)
```

event

The first argument is the name of the event that triggers the handler. You can't force a component to start firing events that it doesn't fire, so make sure that this argument corresponds to an event that the component fires. The `<aura:registerEvent>` tag in a component's markup advertises an event that the component fires.

- For a component event, set this argument to match the `name` attribute of the `<aura:registerEvent>` tag.

- For an application event, set this argument to match the event descriptor in the format `namespace:eventName`.

handler

The second argument is the action that handles the event. The format is similar to the value you would put in the `action` attribute in the `<aura:handler>` tag if the handler was statically defined in the markup. There are two options for this argument.

- To use a controller action, use the format: `cmp.getReference("c.actionName")`.
- To use an anonymous function, use the format:

```
function(auraEvent) {
    // handling logic here
}
```

For a description of the other arguments, see the [JavaScript API](#) in the Aura Reference app.

You can also add an event handler to a component that is created dynamically in the callback function of `$A.createComponent()`.

For more information, see [Dynamically Creating Components](#).

Example

This component has buttons to fire and handle a component event and an application event.

```
<!--c:dynamicHandler-->
<aura:component>
    <aura:registerEvent name="compEvent" type="c:sampleEvent"/>
    <aura:registerEvent name="appEvent" type="c:appEvent"/>
    <h1>Add dynamic handler for event</h1>
    <p>
        <lightning:button label="Fire component event" onclick="{!!c.fireEvent}" />
        <lightning:button label="Add dynamic event handler for component event"
            onclick="{!!c.addHandler}" />
    </p>
    <p>
        <lightning:button label="Fire application event" onclick="{!!c.fireAppEvent}" />
        <lightning:button label="Add dynamic event handler for application event"
            onclick="{!!c.addHandlerForApp}" />
    </p>
</aura:component>
```

Here's the client-side controller.

```
/* dynamicHandlerController.js */
({
    fireEvent : function(cmp, event) {
        // Get the component event by using the
        // name value from <aura:registerEvent> tag
        var compEvent = cmp.getEvent("compEvent");
        compEvent.fire();
        console.log("Fired a component event");
    },
    addEventHandler : function(cmp, event) {
        // First param matches name attribute in <aura:registerEvent> tag
        cmp.addEventListener("compEvent", cmp.getReference("c.handleEvent"));
    }
});
```

```
        console.log("Added handler for component event");
    },

    handleEvent : function(cmp, event) {
        alert("Handled the component event");
    },

    fireAppEvent : function(cmp, event) {
        var appEvent = $A.get("e.c:appEvent");
        appEvent.fire();
        console.log("Fired an application event");
    },

    addAppEventHandler : function(cmp, event) {
        // Can use cmp.getReference() or anonymous function for handler
        // First param is event descriptor, "c:appEvent", for application events
        cmp.addEventHandler("c:appEvent", cmp.getReference("c.handleAppEvent"));
        // Can alternatively use anonymous function for handler
        //cmp.addEventHandler("c:appEvent", function(auraEvent) {
            // console.log("Handled the application event in anonymous function");
        //});
        console.log("Added handler for application event");
    },

    handleAppEvent : function(cmp, event) {
        alert("Handled the application event");
    }
})
```

Notice the first parameter of the `addEventHandler()` calls. The syntax for a component event is:

```
cmp.addEventHandler("compEvent", cmp.getReference("c.handleEvent"));
```

The syntax for an application event is:

```
cmp.addEventHandler("c:appEvent", cmp.getReference("c.handleAppEvent"));
```

For either a component or application event, you can use an anonymous function as a handler instead of using `cmp.getReference()` for a controller action.

For example, the application event handler could be:

```
cmp.addEventHandler("c:appEvent", function(auraEvent) {
    // add handler logic here
    console.log("Handled the application event in anonymous function");
});
```

SEE ALSO:

[Handling Events with Client-Side Controllers](#)

[Handling Component Events](#)

[Component Library](#)

Dynamically Showing or Hiding Markup

You can use CSS to toggle markup visibility. However, `<aura:if>` is the preferred approach because it defers the creation and rendering of the enclosed element tree until needed.

For an example using `<aura:if>`, see [Best Practices for Conditional Markup](#).

This example uses `$A.util.toggleClass(cmp, 'class')` to toggle visibility of markup.

```
<!--c:toggleCss-->
<aura:component>
    <lightning:button label="Toggle" onclick="{!!c.toggle}" />
    <p aura:id="text">Now you see me</p>
</aura:component>

/*toggleCssController.js*/
({
    toggle : function(component, event, helper) {
        var toggleText = component.find("text");
        $A.util.toggleClass(toggleText, "toggle");
    }
})

/*toggleCss.css*/
.THIS.toggle {
    display: none;
}
```



Note: There's no space in the `.THIS.toggle` selector because we're using the rule to match a `<p>` tag, which is a top-level element. For more information, see [CSS in Components](#).

Add the `c:toggleCss` component to an app. To hide or show the text by toggling the CSS class, click the **Toggle** button.

SEE ALSO:

- [Handling Events with Client-Side Controllers](#)
- [Component Attributes](#)
- [Adding and Removing Styles](#)

Adding and Removing Styles

You can add or remove a CSS style on a component or element during runtime.

To retrieve the class name on a component, use `component.find('myCmp').get('v.class')`, where `myCmp` is the `aura:id` attribute value.

To append and remove CSS classes from a component or element, use the `$A.util.addClass(cmpTarget, 'class')` and `$A.util.removeClass(cmpTarget, 'class')` methods.

Component source

```
<aura:component>
    <div aura:id="changeIt">Change Me!</div><br />
    <lightning:button onclick="{!!c.applyCSS}" label="Add Style" />
```

```
<lightning:button onclick="{!!c.removeCSS}" label="Remove Style" />
</aura:component>
```

CSS source

```
.THIS.changeMe {
    background-color:yellow;
    width:200px;
}
```

Client-side controller source

```
{
    applyCSS: function(cmp, event) {
        var cmpTarget = cmp.find('changeIt');
        $A.util.addClass(cmpTarget, 'changeMe');
    },
    removeCSS: function(cmp, event) {
        var cmpTarget = cmp.find('changeIt');
        $A.util.removeClass(cmpTarget, 'changeMe');
    }
}
```

The buttons in this demo are wired to controller actions that append or remove the CSS styles. To append a CSS style to a component, use `$A.util.addClass(cmpTarget, 'class')`. Similarly, remove the class by using `$A.util.removeClass(cmpTarget, 'class')` in your controller. `cmp.find()` locates the component using the local ID, denoted by `aura:id="changeIt"` in this demo.

Toggling a Class

To toggle a class, use `$A.util.toggleClass(cmp, 'class')`, which adds or removes the class.

The `cmp` parameter can be component or a DOM element.



Note: We recommend using a component instead of a DOM element. If the utility function is not used inside `afterRender()` or `rerender()`, passing in `cmp.getElement()` might result in your class not being applied when the components are rerendered. For more information, see [Events Fired During the Rendering Lifecycle](#) on page 290.

To hide or show markup dynamically, see [Dynamically Showing or Hiding Markup](#) on page 375.

To conditionally set a class for an array of components, pass in the array to `$A.util.toggleClass()`.

```
mapClasses: function(arr, cssClass) {
    for(var cmp in arr) {
        $A.util.toggleClass(arr[cmp], cssClass);
    }
}
```

SEE ALSO:

[Handling Events with Client-Side Controllers](#)

[CSS in Components](#)

[Component Bundles](#)

Which Button Was Pressed?

To find out which button was pressed in a component containing multiple buttons, use `Component.getLocalId()`.

The framework provides two button components—`ui:button` and `lightning:button`.



Note: We recommend that you use `lightning:button`, a button component that comes with Lightning Design System styling.

Let's look at an example with multiple `ui:button` components. Each button has a unique local ID, set by an `aura:id` attribute.

```
<!--c:buttonPressed-->
<aura:component>
    <aura:attribute name="whichButton" type="String" />

    <p>You clicked: {!v.whichButton}</p>

    <ui:button aura:id="button1" label="Click me" press="{!c.nameThatButton}"/>
    <ui:button aura:id="button2" label="Click me too" press="{!c.nameThatButton}"/>
</aura:component>
```

Use `event.getSource()` in the client-side controller to get the button component that was clicked. Call `getLocalId()` to get the `aura:id` of the clicked button.

```
/* buttonPressedController.js */
({
    nameThatButton : function(cmp, event, helper) {
        var whichOne = event.getSource().getLocalId();
        console.log(whichOne);
        cmp.set("v.whichButton", whichOne);
    }
})
```

If you're using `lightning:button`, use the `onclick` event handler instead of the `press` event handler.

```
<aura:component>
    <aura:attribute name="whichButton" type="String" />

    <p>You clicked: {!v.whichButton}</p>

    <lightning:button aura:id="button1" name="buttonname1" label="Click me"
    onclick="{!c.nameThatButton}"/>
    <lightning:button aura:id="button2" name="buttonname2" label="Click me"
    onclick="{!c.nameThatButton}"/>
</aura:component>
```

In the client-side controller, you can use one of the following methods to find out which button was clicked.

- `event.getSource().getLocalId()` returns the `aura:id` of the clicked button.
- `event.getSource().get("v.name")` returns the name of the clicked button.

SEE ALSO:

[Component IDs](#)

[Finding Components by ID](#)

Formatting Dates in JavaScript

The `AuraLocalizationService` JavaScript API provides methods for formatting and localizing dates.

For example, the `formatDate()` method formats a date based on the `formatString` parameter set as the second argument.

```
formatDate (String | Number | Date date, String formatString)
```

The `date` parameter can be a String, Number, or most typically a JavaScript Date. If you provide a String value, use [ISO 8601](#) format to avoid parsing warnings.

The `formatString` parameter contains tokens to format a date and time. For example, "YYYY-MM-DD" formats 15th January, 2017 as "2017-01-15". The default format string comes from the `$Locale` value provider.

This table shows the list of tokens supported in `formatString`.

| Description | Token | Output |
|---|-------|----------------------|
| Day of month | d | 1 ... 31 |
| Day of month | dd | 01 ... 31 |
| Day of month. Deprecated. Use dd, which is identical. | DD | 01 ... 31 |
| Day of week (number) | E | 0 ... 6 |
| Day of week (short name) | EEE | Sun ... Sat |
| Day of week (long name) | EEEE | Sunday ... Saturday |
| Month | M | 1 ... 12 |
| Month | MM | 01 ... 12 |
| Month (short name) | MMM | Jan ... Dec |
| Month (full name) | MMMM | January ... December |
| Year (two digits) | yy | 17 |
| Year (four digits) | yyyy | 2017 |
| Year. Deprecated. Use yyyy, which is identical. | y | 2017 |
| Year. Deprecated. Use yyyy, which is identical. | Y | 2017 |
| Year. Deprecated. Use yy, which is identical. | YY | 17 |
| Year. Deprecated. Use yyyy, which is identical. | YYYY | 2017 |
| Hour of day (1-12) | h | 1 ... 12 |
| Hour of day (0-23) | H | 0 ... 23 |
| Hour of day (00-23) | HH | 00 ... 23 |
| Hour of day (1-24) | k | 1 ... 24 |
| Hour of day (01-24) | kk | 01 ... 24 |

| Description | Token | Output |
|--|-------|-------------------|
| Minute | m | 0 ... 59 |
| Minute | mm | 00 ... 59 |
| Second | s | 0 ... 59 |
| Second | ss | 00 ... 59 |
| Fraction of second | SSS | 000 ... 999 |
| AM or PM | a | AM or PM |
| AM or PM. Deprecated. Use a, which is identical. | A | AM or PM |
| Zone offset from UTC | Z | -12:00 ... +14:00 |
| Quarter of year | Q | 1 ... 4 |
| Week of year | w | 1 ... 53 |
| Week of year | ww | 01 ... 53 |

There are similar methods that differ in their default output values.

- `formatDateTime()`—The default `formatString` outputs datetime instead of date.
- `formatDateTimeUTC()`—Formats a datetime in UTC standard time.
- `formatDateUTC()`—Formats a date in UTC standard time.

For more information on all the methods in `AuraLocalizationService`, see the JavaScript API in the [Aura Reference Doc App](#).



Example: Use `$A.localizationService` to use the methods in `AuraLocalizationService`.

```
var now = new Date();
var dateString = "2017-01-15";

// Returns date in the format "Jun 8, 2017"
console.log($A.localizationService.formatDate(now));

// Returns date in the format "Jan 15, 2017"
console.log($A.localizationService.formatDate(dateString));

// Returns date in the format "2017 01 15"
console.log($A.localizationService.formatDate(dateString, "yyyy MM dd"));

// Returns date in the format "June 08 2017, 01:45:49 PM"
console.log($A.localizationService.formatDate(now, "MMMM dd yyyy, hh:mm:ss a"));

// Returns date in the format "Jun 08 2017, 01:48:26 PM"
console.log($A.localizationService.formatDate(now, "MMM dd yyyy, hh:mm:ss a"));
```

SEE ALSO:

[Localization](#)

Using JavaScript Promises

You can use ES6 Promises in JavaScript code. Promises can simplify code that handles the success or failure of asynchronous calls, or code that chains together multiple asynchronous calls.

If the browser doesn't provide a native version, the framework uses a polyfill so that promises work in all browsers supported for Lightning Experience.

We assume that you are familiar with the fundamentals of promises. For a great introduction to promises, see <https://developers.google.com/web/fundamentals/getting-started/primers/promises>.

Promises are an optional feature. Some people love them, some don't. Use them if they make sense for your use case.

Create a Promise

This `firstPromise` function returns a Promise.

```
firstPromise : function() {
    return new Promise($A.getCallback(function(resolve, reject) {
        // do something

        if /* success */ {
            resolve("Resolved");
        }
        else {
            reject("Rejected");
        }
    )));
}
```

The promise constructor determines the conditions for calling `resolve()` or `reject()` on the promise.

Chaining Promises

When you need to coordinate or chain together multiple callbacks, promises can be useful. The generic pattern is:

```
firstPromise()
    .then(
        // resolve handler
        $A.getCallback(function(result) {
            return anotherPromise();
        }),
        // reject handler
        $A.getCallback(function(error) {
            console.log("Promise was rejected: ", error);
            return errorRecoveryPromise();
        })
    )
    .then(
        // resolve handler
        $A.getCallback(function() {
            return yetAnotherPromise();
        })
    )
```

```
    })
);
```

The `then()` method chains multiple promises. In this example, each resolve handler returns another promise.

`then()` is part of the Promises API. It takes two arguments:

1. A callback for a fulfilled promise (resolve handler)
2. A callback for a rejected promise (reject handler)

The first callback, `function(result)`, is called when `resolve()` is called in the promise constructor. The `result` object in the callback is the object passed as the argument to `resolve()`.

The second callback, `function(error)`, is called when `reject()` is called in the promise constructor. The `error` object in the callback is the object passed as the argument to `reject()`.

 **Note:** The two callbacks are wrapped by `$A.getCallback()` in our example. What's that all about? Promises execute their resolve and reject functions asynchronously so the code is outside the Lightning event loop and normal rendering lifecycle. If the resolve or reject code makes any calls to the Lightning Component framework, such as setting a component attribute, use `$A.getCallback()` to wrap the code. For more information, see [Modifying Components Outside the Framework Lifecycle](#) on page 362.

Always Use `catch()` or a Reject Handler

The reject handler in the first `then()` method returns a promise with `errorRecoveryPromise()`. Reject handlers are often used "midstream" in a promise chain to trigger an error recovery mechanism.

The Promises API includes a `catch()` method to optionally catch unhandled errors. Always include a reject handler or a `catch()` method in your promise chain.

Throwing an error in a promise doesn't trigger `window.onerror`, which is where the framework configures its global error handler. If you don't have a `catch()` method, keep an eye on your browser's console during development for reports about uncaught errors in a promise. To show an error message in a `catch()` method, use `$A.reportError()`. The syntax for `catch()` is:

```
promise.then(...)  
  .catch(function(error) {  
    $A.reportError("error message here", error);  
  });
```

For more information on `catch()`, see the [Mozilla Developer Network](#).

Don't Use Storable Actions in Promises

The framework stores the response for storable actions in client-side cache. This stored response can dramatically improve the performance of your app and allow offline usage for devices that temporarily don't have a network connection. Storable actions are only suitable for read-only actions.

Storable actions might have their callbacks invoked more than once: first with cached data, then with updated data from the server. The multiple invocations don't align well with promises, which are expected to resolve or reject only once.

SEE ALSO:

[Storable Actions](#)

Making API Calls from Components

By default, you can't make calls to third-party APIs from client-side code. Add a remote site as a CSP Trusted Site to allow client-side component code to load assets from and make API requests to that site's domain.

The Lightning Component framework uses Content Security Policy ([CSP](#)) to impose restrictions on content. The main objective is to help prevent cross-site scripting ([XSS](#)) and other code injection attacks. Lightning apps are served from a different domain than Salesforce APIs, and the default CSP policy doesn't allow API calls from JavaScript code. You change the policy, and the content of the CSP header, by adding CSP Trusted Sites.

! **Important:** You can't load JavaScript resources from a third-party site, even if it's a CSP Trusted Site. To use a JavaScript library from a third-party site, add it to a static resource, and then add the static resource to your component. After the library is loaded from the static resource, you can use it as normal.

Sometimes, you have to make API calls from server-side controllers rather than client-side code. In particular, you can't make calls to Salesforce APIs from client-side Aura component code. For information about making API calls from server-side controllers, see [Making API Calls from Apex](#) on page 411.

SEE ALSO:

[Content Security Policy Overview](#)

[Create CSP Trusted Sites to Access Third-Party APIs](#)

Create CSP Trusted Sites to Access Third-Party APIs

The Lightning Component framework uses Content Security Policy ([CSP](#)) to impose restrictions on content. The main objective is to help prevent cross-site scripting ([XSS](#)) and other code injection attacks. To use third-party APIs that make requests to an external (non-Salesforce) server or to use a WebSocket connection, add a CSP Trusted Site.

[CSP](#) is a W3C standard that defines rules to control the source of content that can be loaded on a page. All CSP rules work at the page level, and apply to all components and libraries. By default, the framework's headers allow content to be loaded only from secure (HTTPS) URLs and forbid XHR requests from JavaScript.

When you define a CSP Trusted Site, the site's URL is added to the list of allowed sites for the following directives in the CSP header.

- connect-src
- frame-src
- img-src
- style-src
- font-src
- media-src

This change to the CSP header directives allows Lightning components to load resources, such as images, styles, and fonts, from the site. It also allows client-side code to make requests to the site.

! **Important:** You can't load JavaScript resources from a third-party site, even if it's a CSP Trusted Site. To use a JavaScript library from a third-party site, add it to a static resource, and then add the static resource to your component. After the library is loaded from the static resource, you can use it as normal.

EDITIONS

Available in: Salesforce Classic and Lightning Experience

Available in: **Developer**, **Enterprise**, **Performance**, and **Unlimited**

USER PERMISSIONS

To create, read, update, and delete:

- Customize Application or Modify All Data

1. From Setup, enter *CSP* in the **Quick Find** box, then select **CSP Trusted Sites**.

This page displays a list of any CSP Trusted Sites already registered, and provides additional information about each site, including site name and URL.

2. Select **New Trusted Site**.

3. Name the Trusted Site.

For example, enter *Google Maps*.

4. Enter the URL for the Trusted Site.

- The URL must include a domain name, and can include a port. For example, `https://example.com:8080/path`.
- For a third-party API, the URL must begin with `https://`. For example, `https://example.com/apiserver`.
- For a WebSocket connection, the URL must begin with `wss://`. For example, `wss://example.com/socketserver`.

The WebSocket API is a web standard for two-way communication between a user's browser and an external server. With this API, you can send messages to a server and receive event-driven responses without having to poll the server for a reply.

 **Note:** CSP requires secure (`https` or `wss`) connections for external resources because an insecure (`http` or `ws`) connection would compromise the security of your org.

5. Optional: Enter a description for the Trusted Site.

6. Optional: To temporarily disable a Trusted Site without actually deleting it, deselect the **Active** checkbox.

7. Select the Context for this trusted site to control the scope of the approval.

| Context | Description |
|-------------|--|
| All | (Default)CSP header is approved for both your organization's Lightning Experience and Lightning Communities. |
| LEX | CSP header is approved only for your organization's Lightning Experience. |
| Communities | CSP header is approved only for your organization's Lightning Communities. |

 **Note:** To enable corresponding access for Visualforce or Apex, create a Remote Site.

8. Select **Save**.

CSP isn't enforced by all browsers. For a list of browsers that enforce CSP, see [caniuse.com](#).

IE11 doesn't support CSP, so we recommend using other supported browsers for enhanced security.

SEE ALSO:

[Content Security Policy Overview](#)

[Making API Calls from Components](#)

[Browser Support Considerations for Lightning Components](#)

[Mozilla Developer Network: The WebSocket API](#)

CHAPTER 10 Using Apex

In this chapter ...

- [Creating Server-Side Logic with Controllers](#)
- [Working with Salesforce Records](#)
- [Testing Your Apex Code](#)
- [Making API Calls from Apex](#)
- [Creating Components in Apex](#)

Use Apex to write server-side code, such as controllers and test classes.

Server-side controllers handle requests from client-side controllers. For example, a client-side controller might handle an event and call a server-side controller action to persist a record. A server-side controller can also load your record data.

Creating Server-Side Logic with Controllers

The framework supports client-side and server-side controllers. An event is always wired to a client-side controller action, which can in turn call a server-side controller action. For example, a client-side controller might handle an event and call a server-side controller action to persist a record.

Server-side actions need to make a round trip, from the client to the server and back again, so they usually complete more slowly than client-side actions.

For more details on the process of calling a server-side action, see [Calling a Server-Side Action](#) on page 388.

IN THIS SECTION:

[Apex Server-Side Controller Overview](#)

Create a server-side controller in Apex and use the `@AuraEnabled` annotation to enable access to the controller method.

[AuraEnabled Annotation](#)

The `AuraEnabled` annotation enables Lightning components to access Apex methods and properties.

[Creating an Apex Server-Side Controller](#)

Use the Developer Console to create an Apex server-side controller.

[Calling a Server-Side Action](#)

Call a server-side controller action from a client-side controller. In the client-side controller, you set a callback, which is called after the server-side action is completed. A server-side action can return any object containing serializable JSON data.

[Passing Data to an Apex Controller](#)

Use `action.setParams()` in JavaScript to set data to pass to an Apex controller.

[Returning Data from an Apex Server-Side Controller](#)

Return results from a server-side controller to a client-side controller using the `return` statement. Results data must be serializable into JSON format.

[Returning Errors from an Apex Server-Side Controller](#)

Create and throw a `System.AuraHandledException` from your server-side controller to return a custom error message.

[Queueing of Server-Side Actions](#)

The framework queues up actions before sending them to the server. This mechanism is largely transparent to you when you're writing code but it enables the framework to minimize network traffic by batching multiple actions into one request (XHR).

[Foreground and Background Actions](#)

Foreground actions are the default. An action can be marked as a background action. This is useful when you want your app to remain responsive to a user while it executes a low priority, long-running action. A rough guideline is to use a background action if it takes more than five seconds for the response to return from the server.

[Storable Actions](#)

Enhance your component's performance by marking actions as storable (cacheable) to quickly show cached data from client-side storage without waiting for a server trip. If the cached data is stale, the framework retrieves the latest data from the server. Caching is especially beneficial for users on high latency, slow, or unreliable connections such as 3G networks.

[Abortable Actions](#)

Mark an action as abortable to make it potentially abortable while it's queued to be sent to the server. An abortable action in the queue is not sent to the server if the component that created the action is no longer valid, that is `cmp.isValid() == false`. A component is automatically destroyed and marked invalid by the framework when it is unrendered.

Apex Server-Side Controller Overview

Create a server-side controller in Apex and use the `@AuraEnabled` annotation to enable access to the controller method.

Only methods that you have explicitly annotated with `@AuraEnabled` are exposed. Calling server-side actions aren't counted against your org's API limits. However, your server-side controller actions are written in Apex, and as such are subject to all the usual Apex limits.

This Apex controller contains a `serverEcho` action that prepends a string to the value passed in.

```
public with sharing class SimpleServerSideController {  
  
    //Use @AuraEnabled to enable client- and server-side access to the method  
    @AuraEnabled  
    public static String serverEcho(String firstName) {  
        return ('Hello from the server, ' + firstName);  
    }  
}
```

In addition to using the `@AuraEnabled` annotation, your Apex controller must follow these requirements.

- Methods must be `static` and marked `public` or `global`. Non-static methods aren't supported.
- If a method returns an object, instance methods that retrieve the value of the object's instance field must be `public`.
- Use unique names for client-side and server-side actions in a component. A JavaScript function (client-side action) with the same name as an Apex method (server-side action) can lead to hard-to-debug issues. In debug mode, the framework logs a browser console warning about the clashing client-side and server-side action names.

 **Tip:** Don't store component state in your controller (client-side or server-side). Store state in a component's client-side attributes instead.

For more information, see Classes in the [Apex Developer Guide](#).

SEE ALSO:

- [Calling a Server-Side Action](#)
- [Creating an Apex Server-Side Controller](#)
- [AuraEnabled Annotation](#)

AuraEnabled Annotation

The `AuraEnabled` annotation enables Lightning components to access Apex methods and properties.

The `AuraEnabled` annotation is overloaded, and is used for two separate and distinct purposes.

- Use `@AuraEnabled` on Apex **class static methods** to make them accessible as remote controller actions in your Lightning components.
- Use `@AuraEnabled` on Apex **instance methods and properties** to make them serializable when an instance of the class is returned as data from a server-side action.

 **Important:**

- Don't mix-and-match these different uses of `@AuraEnabled` in the same Apex class.
- Only static `@AuraEnabled` Apex methods can be called from client-side code. Visualforce-style instance properties and getter/setter methods aren't available. Use client-side component attributes instead.

[Component Security Boundaries and Encapsulation](#)

In Apex, every method that is annotated @AuraEnabled should be treated as a webservice interface. That is, the developer should assume that an attacker can call this method with any parameter, even if the developer's client-side code does not invoke the method or invokes it using only sanitized parameters. Therefore the parameters of an @AuraEnabled method should:

- not be placed into a SOQL query unsanitized
- not be trusted to specify which fields and objects a user can access

Whenever an @AuraEnabled method modifies sObjects, full CRUD/FLS as well as sharing checks should be made to ensure that the client does not elevate their privileges when invoking this method. These checks need to be performed on the server (in Apex). Note that this is different than the situation with VisualForce, in which CRUD/FLS checks can be performed for you by the visualforce presentation layer. This means porting code from VisualForce to Lightning requires the addition of CRUD/FLS checks each time an sObject is accessed.

Because Lightning components are meant to be re-usable and shareable, each global or public attribute should be viewed as untrusted from the point of view of the component's internal logic. In other words, don't take the contents of an attribute and render them directly to the DOM via innerHTML or \$().html(). It does not matter whether, in your app, the attributes are provided by another component you control. When you need to perform a raw HTML write or set an href attribute, then the attribute must be marked sanitized in your javascript code.

An important aspect to understand is how session authentication works for your AuraEnabled components. If a community user's session expires, and the rendered page contains lightning components that can invoke custom apex methods (AuraEnabled), the methods will be invoked as the community site's guest user. Plan your implementation to either provide/revoke access to the site guest user or to monitor for session time-outs to invoke login requests as needed.

Caching Method Results

To improve runtime performance, set `@AuraEnabled(cacheable=true)` to cache the method results on the client. To set `cacheable=true`, a method must only get data, it can't mutate data.

Marking a method as storable (cacheable) improves your component's performance by quickly showing cached data from client-side storage without waiting for a server trip. If the cached data is stale, the framework retrieves the latest data from the server. Caching is especially beneficial for users on high latency, slow, or unreliable connections such as 3G networks.

To cache data returned from an Apex method for any component with an API version of 44.0 or higher, you must annotate the Apex method with `@AuraEnabled(cacheable=true)`. For example:

```
@AuraEnabled(cacheable=true)
public static Account getAccount(Id accountId) {
    // your code here
}
```

Prior to API version 44.0, to cache data returned from an Apex method, you had to call `setStorable()` in JavaScript code on every action that called the Apex method. For API version of 44.0 or higher, you must mark the Apex method as storable (cacheable) and you can get rid of any `setStorable()` calls in JavaScript code. The Apex annotation approach is better because it centralizes your caching notation for a method in the Apex class.

SEE ALSO:

[Returning Data from an Apex Server-Side Controller](#)
[Custom Apex Class Types](#)
[Storable Actions](#)

Creating an Apex Server-Side Controller

Use the Developer Console to create an Apex server-side controller.

1. Open the Developer Console.
2. Click **File > New > Apex Class**.
3. Enter a name for your server-side controller.
4. Click **OK**.
5. Enter a method for each server-side action in the body of the class.
Add the `@AuraEnabled` annotation to a method to expose it as a server-side action. Additionally, server-side actions must be `static` methods, and either `global` or `public`.
6. Click **File > Save**.
7. Open the component that you want to wire to the new controller class.
8. Add a `controller` system attribute to the `<aura:component>` tag to wire the component to the controller. For example:

```
<aura:component controller="SimpleServerSideController">
```

SEE ALSO:

[Salesforce Help: Open the Developer Console](#)

[Returning Data from an Apex Server-Side Controller](#)

[AuraEnabled Annotation](#)

Calling a Server-Side Action

Call a server-side controller action from a client-side controller. In the client-side controller, you set a callback, which is called after the server-side action is completed. A server-side action can return any object containing serializable JSON data.

A client-side controller is a JavaScript object in object-literal notation containing a map of name-value pairs.

Let's say that you want to trigger a server-call from a component. The following component contains a button that's wired to a client-side controller `echo` action. `SimpleServerSideController` contains a method that returns a string passed in from the client-side controller.

```
<aura:component controller="SimpleServerSideController">
    <aura:attribute name="firstName" type="String" default="world"/>
    <lightning:button label="Call server" onclick="{!c.echo}" />
</aura:component>
```

This client-side controller includes an `echo` action that executes a `serverEcho` method on a server-side controller.

 **Tip:** Use unique names for client-side and server-side actions in a component. A JavaScript function (client-side action) with the same name as an Apex method (server-side action) can lead to hard-to-debug issues. In debug mode, the framework logs a browser console warning about the clashing client-side and server-side action names.

```
{
    "echo" : function(cmp) {
        // create a one-time use instance of the serverEcho action
        // in the server-side controller
        var action = cmp.get("c.serverEcho");
        action.setParams({ firstName : cmp.get("v.firstName") });

        // Create a callback that is executed after
        // the server-side action returns
```

```

action.setCallback(this, function(response) {
    var state = response.getState();
    if (state === "SUCCESS") {
        // Alert the user with the value returned
        // from the server
        alert("From server: " + response.getReturnValue());

        // You would typically fire a event here to trigger
        // client-side notification that the server-side
        // action is complete
    }
    else if (state === "INCOMPLETE") {
        // do something
    }
    else if (state === "ERROR") {
        var errors = response.getError();
        if (errors) {
            if (errors[0] && errors[0].message) {
                console.log("Error message: " +
                           errors[0].message);
            }
        } else {
            console.log("Unknown error");
        }
    }
});

// optionally set storable, abortable, background flag here

// A client-side action could cause multiple events,
// which could trigger other events and
// other server-side action calls.
// $A.enqueueAction adds the server-side action to the queue.
$A.enqueueAction(action);
}
})

```

In the client-side controller, we use the value provider of `c` to invoke a server-side controller action. We also use the `c` syntax in markup to invoke a client-side controller action.

The `cmp.get("c.serverEcho")` call indicates that we're calling the `serverEcho` method in the server-side controller. The method name in the server-side controller must match everything after the `c.` in the client-side call. In this case, that's `serverEcho`.

The implementation of the `serverEcho` Apex method is shown in [Apex Server-Side Controller Overview](#).

Use `action.setParams()` to set data to be passed to the server-side controller. The following call sets the value of the `firstName` argument on the server-side controller's `serverEcho` method based on the `firstName` attribute value.

```
action.setParams({ firstName : cmp.get("v.firstName") });
```

`action.setCallback()` sets a callback action that is invoked after the server-side action returns.

```
action.setCallback(this, function(response) { ... });
```

The server-side action results are available in the `response` variable, which is the argument of the callback.

`response.getState()` gets the state of the action returned from the server.



Note: You don't need a `cmp.isValid()` check in the callback in a client-side controller when you reference the component associated with the client-side controller. The framework automatically checks that the component is valid.

`response.getReturnValue()` gets the value returned from the server. In this example, the callback function alerts the user with the value returned from the server.

`$A.enqueueAction(action)` adds the server-side controller action to the queue of actions to be executed. All actions that are enqueued will run at the end of the event loop. Rather than sending a separate request for each individual action, the framework processes the event chain and batches the actions in the queue into one request. The actions are asynchronous and have callbacks.



Tip: If your action is not executing, make sure that you're not executing code outside the framework's normal rerendering lifecycle.

For example, if you use `window.setTimeout()` in an event handler to execute some logic after a time delay, wrap your code in `$A.getCallback()`. You don't need to use `$A.getCallback()` if your code is executed as part of the framework's call stack; for example, your code is handling an event or in the callback for a server-side controller action.

Client Payload Data Limit

Use `action.setParams()` to set data for an action to be passed to a server-side controller.

The framework batches the actions in the queue into one server request. The request payload includes all of the actions and their data serialized into JSON. The request payload limit is 4 MB.

IN THIS SECTION:

[Action States](#)

Call a server-side controller action from a client-side controller. The action can have different states during processing.

SEE ALSO:

[Handling Events with Client-Side Controllers](#)

[Passing Data to an Apex Controller](#)

[Queueing of Server-Side Actions](#)

[Action States](#)

[Checking Component Validity](#)

Action States

Call a server-side controller action from a client-side controller. The action can have different states during processing.

The possible action states are:

NEW

The action was created but is not in progress yet

RUNNING

The action is in progress

SUCCESS

The action executed successfully

ERROR

The server returned an error

INCOMPLETE

The server didn't return a response. The server might be down or the client might be offline. The framework guarantees that an action's callback is always invoked as long as the component is valid. If the socket to the server is never successfully opened, or closes abruptly, or any other network error occurs, the XHR resolves and the callback is invoked with state equal to `INCOMPLETE`.

ABORTED

The action was aborted. This action state is deprecated. A callback for an aborted action is never executed so you can't do anything to handle this state.

SEE ALSO:

[Calling a Server-Side Action](#)

Passing Data to an Apex Controller

Use `action.setParams()` in JavaScript to set data to pass to an Apex controller.

This example sets the value of the `firstName` argument on an Apex controller's `serverEcho` method based on the `firstName` attribute value.

```
var action = cmp.get("c.serverEcho");
action.setParams({ firstName : "Jennifer" }));
```

The request payload includes the action data serialized into JSON.

Here's the Apex controller method.

```
@AuraEnabled
public static String serverEcho(String firstName) {
    return ('Hello from the server, ' + firstName);
}
```

The framework deserializes the action data into the appropriate Apex type. In this example, we have a `String` parameter called `firstName`.

Example with Different Data Types

Let's look at an application that sends data of various types to an Apex controller. Each button starts the sequence of passing data of a different type.

```
<!-- actionParamTypes.app -->
<aura:application controller="ApexParamTypesController">
    <lightning:button label="putboolean" onclick="{!!c.putbooleanc}" />
    <lightning:button label="putint" onclick="{!!c.putintc}" />
    <lightning:button label="putlong" onclick="{!!c.putlongc}" />
    <lightning:button label="putdecimal" onclick="{!!c.putdecimalc}" />
    <lightning:button label="putdouble" onclick="{!!c.putdoublec}" />
    <lightning:button label="putstring" onclick="{!!c.putstringc}" />
    <lightning:button label="putobject" onclick="{!!c.putobjectc}" />
    <lightning:button label="putblob" onclick="{!!c.putblobc}" />
    <lightning:button label="putdate" onclick="{!!c.putdatec}" />
    <lightning:button label="putdatetime" onclick="{!!c.putdatetimetc}" />
    <lightning:button label="puttime" onclick="{!!c.puttimec}" />
    <lightning:button label="putlistoflistoflistofstring"
        onclick="{!!c.putlistoflistoflistofstringc}" />
```

```
<lightning:button label="putmapofstring" onclick="{!!c.putmapofstringc}" />
<lightning:button label="putcustomclass" onclick="{!!c.putcustomclassc}" />
</aura:application>
```

Here's the application's JavaScript controller. Each action calls the helper's `putdatatype` method, which queues up the actions to send to the Apex controller. The method has three parameters:

1. The component
2. The Apex method name
3. The data to pass to the Apex method

```
// actionParamTypesController.js
({
    putbooleanc : function(component, event, helper) {
        helper.putdatatype(component, "c.pboolean", true);
    },
    putintc : function(component, event, helper) {
        helper.putdatatype(component, "c.pint", 10);
    },
    putlongc : function(component, event, helper) {
        helper.putdatatype(component, "c.plong", 2147483648);
    },
    putdecimalc : function(component, event, helper) {
        helper.putdatatype(component, "c.pdecimal", 10.80);
    },
    putdoublec : function(component, event, helper) {
        helper.putdatatype(component, "c.pdouble", 10.80);
    },
    putstringc : function(component, event, helper) {
        helper.putdatatype(component, "c.pstring", "hello!");
    },
    putobjectc : function(component, event, helper) {
        helper.putdatatype(component, "c.pobject", true);
    },
    putblobc : function(component, event, helper) {
        helper.putdatatype(component, "c.pblob", "some blob as string");
    },
    // Date value is in ISO 8601 date format
    putdatec : function(component, event, helper) {
        helper.putdatatype(component, "c.pdate", "1997-01-31");
    },
    // Datetime value is in ISO 8601 datetime format
    putdatetimec : function(component, event, helper) {
        helper.putdatatype(component, "c.pdatetime", "1997-01-31T15:08:16.000Z");
    },
    // Set time in milliseconds.
    // You can use (new Date()).getTime() to set the milliseconds
    puttimec : function(component, event, helper) {
        helper.putdatatype(component, "c.ptime", 3723004);
        //helper.putdatatype(component, "c.ptime", (new Date()).getTime());
    },
    putlistoflistoflistofstringc : function(component, event, helper) {
        helper.putdatatype(component, "c.plistoflistoflistofstring",
[[['a','b'],['c','d']],[['e','f']]]);
    }
});
```

```

        },
        putmapofstringc : function(component, event, helper) {
            helper.putdatatype(component, "c.pmapofstring", {k1: 'v1'});
        },
        putcustomclassc : function(component, event, helper) {
            helper.putdatatype(component, "c.pcustomclass", {
                s: 'my string',
                i: 10,
                l: ['list value 1','list value 2'],
                m: {k1: 'map value'},
                os: {b: true}
            });
        },
    })
)

```

The helper has a utility method to send the data to an Apex controller.

```

// actionParamTypesHelper.js
({
    putdatatype : function(component, actionName, val) {
        var action = component.get(actionName);
        action.setParams({ v : val });
        action.setCallback(this, function(response) {
            console.log(response.getReturnValue());
        });
        $A.enqueueAction(action);
    }
})

```

Here's the Apex controller.

```

public class ApexParamTypesController {
    @AuraEnabled
    public static Boolean pboolean(Boolean v) {
        System.debug(v);
        return v;
    }
    @AuraEnabled
    public static Integer pint(Integer v) {
        System.debug(v+v);
        return v;
    }
    @AuraEnabled
    public static Long plong(Long v) {
        System.debug(v);
        return v;
    }
    @AuraEnabled
    public static Decimal pdecimal(Decimal v) {
        System.debug(v);
        return v;
    }
    @AuraEnabled
    public static Double pdouble(Double v) {
        System.debug(v);
    }
}

```

```

        return v;
    }
    @AuraEnabled
    public static String pstring(String v) {
        System.debug(v.capitalize());
        return v;
    }
    @AuraEnabled
    public static Object pobject(Object v) {
        System.debug(v);
        return v;
    }
    @AuraEnabled
    public static Blob pblob(Blob v) {
        System.debug(v.toString());
        return v;
    }
    @AuraEnabled
    public static Date pdate(Date v) {
        System.debug(v);
        return v;
    }
    @AuraEnabled
    public static DateTime pdatetime(DateTime v) {
        System.debug(v);
        return v;
    }
    @AuraEnabled
    public static Time ptime(Time v) {
        System.debug(v);
        return v;
    }
    @AuraEnabled
    public static List<List<List<String>>> plistoflistoflistofstring(List<List<List<String>>>
v) {
        System.debug(v);
        return v;
    }
    @AuraEnabled
    public static Map<String, String> pmapofstring(Map<String, String> v) {
        System.debug(v);
        return v;
    }
    @AuraEnabled
    public static MyCustomApexClass pcustomclass(MyCustomApexClass v) {
        System.debug(v);
        return v;
    }
}
}

```

The `pcustomclass()` Apex method has a parameter that's a custom Apex type, `MyCustomApexClass`. Each property in the Apex class must have an `@AuraEnabled` annotation, as well as a getter and setter.

```
public class MyCustomApexClass {
    @AuraEnabled
```

```
public String s {get; set;}
@AuraEnabled
public Integer i {get; set;}
@AuraEnabled
public List<String> l {get; set;}
@AuraEnabled
public Map <String, String> m {get; set;}
@AuraEnabled
public MyOtherCustomApexClass os {get; set;}
}
```

The `MyCustomApexClass` Apex class has a property with a type of another custom Apex class, `MyOtherCustomApexClass`.

```
public class MyOtherCustomApexClass {
    @AuraEnabled
    public Boolean b {get; set;}
}
```

SEE ALSO:

[Queueing of Server-Side Actions](#)

[Apex Server-Side Controller Overview](#)

Returning Data from an Apex Server-Side Controller

Return results from a server-side controller to a client-side controller using the `return` statement. Results data must be serializable into JSON format.

Return data types can be any of the following.

- Simple—String, Integer, and so on. See [Basic Types](#) for details.
- sObject—standard and custom sObjects are both supported. See [Standard and Custom Object Types](#).
- Apex—an instance of an Apex class. (Most often a custom class.) See [Custom Apex Class Types](#).
- Collection—a collection of any of the other types. See [Collection Types](#).

Returning Apex Objects

Here's an example of a controller that returns a collection of custom Apex objects.

```
public with sharing class SimpleAccountController {

    @AuraEnabled
    public static List<SimpleAccount> getAccounts() {

        // Perform isAccessible() check here

        // SimpleAccount is a simple "wrapper" Apex class for transport
        List<SimpleAccount> simpleAccounts = new List<SimpleAccount>();

        List<Account> accounts = [SELECT Id, Name, Phone FROM Account LIMIT 5];
        for (Account acct : accounts) {
            simpleAccounts.add(new SimpleAccount(acct.Id, acct.Name, acct.Phone));
        }
    }
}
```

```
        return simpleAccounts;
    }
}
```

When an instance of an Apex class is returned from a server-side action, the instance is serialized to JSON by the framework. Only the values of `public` instance properties and methods annotated with `@AuraEnabled` are serialized and returned.

For example, here's a simple "wrapper" Apex class that contains a few details for an account record. This class is used to package a few details of an account record in a serializable format.

```
public class SimpleAccount {

    @AuraEnabled public String Id { get; set; }
    @AuraEnabled public String Name { get; set; }
    public String Phone { get; set; }

    // Trivial constructor, for server-side Apex -> client-side JavaScript
    public SimpleAccount(String id, String name, String phone) {
        this.Id = id;
        this.Name = name;
        this.Phone = phone;
    }

    // Default, no-arg constructor, for client-side -> server-side
    public SimpleAccount() {}

}
```

When returned from a remote Apex controller action, the `Id` and `Name` properties are defined on the client-side. However, because it doesn't have the `@AuraEnabled` annotation, the `Phone` property isn't serialized on the server side, and isn't returned as part of the result data.

SEE ALSO:

[AuraEnabled Annotation](#)

[Custom Apex Class Types](#)

Returning Errors from an Apex Server-Side Controller

Create and throw a `System.AuraHandledException` from your server-side controller to return a custom error message.

Errors happen. Sometimes they're expected, such as invalid input from a user, or a duplicate record in a database. Sometimes they're unexpected, such as... Well, if you've been programming for any length of time, you know that the range of unexpected errors is nearly infinite.

When your server-side controller code experiences an error, two things can happen. You can catch it there and handle it in Apex. Otherwise, the error is passed back in the controller's response.

If you handle the error Apex, you again have two ways you can go. You can process the error, perhaps recovering from it, and return a normal response to the client. Or, you can create and throw an `AuraHandledException`.

The benefit of throwing `AuraHandledException`, instead of letting a system exception be returned, is that you have a chance to handle the exception more gracefully in your client code. System exceptions have important details stripped out for security purposes, and result in the dreaded "An internal server error has occurred..." message. Nobody likes that. When you use an

AuraHandledException you have an opportunity to add some detail back into the response returned to your client-side code. More importantly, you can choose a better message to show your users.

Here's an example of creating and throwing an `AuraHandledException` in response to bad input. However, the real benefit of using `AuraHandledException` comes when you use it in response to a system exception. For example, throw an `AuraHandledException` in response to catching a DML exception, instead of allowing that to propagate down to your client component code.

```
public with sharing class SimpleErrorController {

    static final List<String> BAD_WORDS = new List<String> {
        'bad',
        'words',
        'here'
    };

    @AuraEnabled
    public static String helloOrThrowAnError(String name) {

        // Make sure we're not seeing something naughty
        for(String badWordStem : BAD_WORDS) {
            if(name.equalsIgnoreCase(badWordStem)) {
                // How rude! Gracefully return an error...
                throw new AuraHandledException('NSFW name detected.');
            }
        }

        // No bad word found, so...
        return ('Hello ' + name + '!');
    }

}
```

Queueing of Server-Side Actions

The framework queues up actions before sending them to the server. This mechanism is largely transparent to you when you're writing code but it enables the framework to minimize network traffic by batching multiple actions into one request (XHR).

The batching of actions is also known as *boxcar'ing*, similar to a train that couples boxcars together.

The framework uses a stack to keep track of the actions to send to the server. When the browser finishes processing events and JavaScript on the client, the enqueued actions on the stack are sent to the server in a batch.



Tip: If your action is not executing, make sure that you're not executing code outside the framework's normal rerendering lifecycle.

For example, if you use `window.setTimeout()` in an event handler to execute some logic after a time delay, wrap your code in `$A.getCallback()`.

There are some properties that you can set on an action to influence how the framework manages the action while it's in the queue waiting to be sent to the server. For more information, see:

- [Foreground and Background Actions](#) on page 398
- [Storable Actions](#) on page 399

- [Abortable Actions](#) on page 402

SEE ALSO:

[Modifying Components Outside the Framework Lifecycle](#)

Foreground and Background Actions

Foreground actions are the default. An action can be marked as a background action. This is useful when you want your app to remain responsive to a user while it executes a low priority, long-running action. A rough guideline is to use a background action if it takes more than five seconds for the response to return from the server.

Batching of Actions

Multiple queued foreground actions are batched in a single request (XHR) to minimize network traffic. The batching of actions is also known as *boxcar'ing*, similar to a train that couples boxcars together.

The server sends the XHR response to the client when all actions have been processed on the server. If a long-running action is in the boxcar, the XHR response is held until that long-running action completes. Marking an action as background results in that action being sent separately from any foreground actions. The separate transmission ensures that the background action doesn't impact the response time of the foreground actions.

When the server-side actions in the queue are executed, the foreground actions execute first and then the background actions execute. Background actions run in parallel with foreground actions and responses of foreground and background actions may come back in either order.

We don't make any guarantees for the order of execution of action callbacks. XHR responses may return in a different order than the order in which the XHR requests were sent due to server processing time.

 **Note:** Don't rely on each background action being sent in its own request as that behavior isn't guaranteed and it can lead to performance issues. Remember that the motivation for background actions is to isolate long-running requests into a separate request to avoid slowing the response for foreground actions.

If two actions must be executed sequentially, the component must orchestrate the ordering. The component can enqueue the first action. In the first action's callback, the component can then enqueue the second action.

Framework-Managed Request Throttling

The framework throttles foreground and background requests separately. This means that the framework can control the number of foreground requests and the number of background actions running at any time. The framework automatically throttles requests and it's not user controlled. The framework manages the number of foreground and background XHRs, which varies depending on available resources.

Even with separate throttling, background actions might affect performance in some conditions, such as an excessive number of requests to the server.

Setting Background Actions

To set an action as a background action, call the `setBackground()` method on the action object in JavaScript.

```
// set up the server-action action
var action = cmp.get("c.serverEcho");
// optionally set actions params
```

```
//action.setParams({ firstName : cmp.get("v.firstName") }) ;
// set as a background action
action.setBackground();
```

 **Note:** A background action can't be set back to a foreground action. In other words, calling `setBackground` to set it to `false` will have no effect.

SEE ALSO:

- [Queueing of Server-Side Actions](#)
- [Calling a Server-Side Action](#)

Storable Actions

Enhance your component's performance by marking actions as storable (cacheable) to quickly show cached data from client-side storage without waiting for a server trip. If the cached data is stale, the framework retrieves the latest data from the server. Caching is especially beneficial for users on high latency, slow, or unreliable connections such as 3G networks.

 **Warning:**

- A storable action might result in no call to the server. Never mark as storable an action that updates or deletes data.
- For storable actions in the cache, the framework returns the cached response immediately and also refreshes the data if it's stale. Therefore, storable actions might have their callbacks invoked more than once: first with cached data, then with updated data from the server.

Most server requests are read-only and idempotent, which means that a request can be repeated or retried as often as necessary without causing data changes. The responses to idempotent actions can be cached and quickly reused for subsequent identical actions. For storable actions, the key for determining an identical action is a combination of:

- Apex controller name
- Method name
- Method parameter values

Marking an Action as Storable

To cache data returned from an Apex method for any component with an API version of 44.0 or higher, you must annotate the Apex method with `@AuraEnabled(cacheable=true)`. For example:

```
@AuraEnabled(cacheable=true)
public static Account getAccount(Id accountId) {
    // your code here
}
```

Prior to API version 44.0, to cache data returned from an Apex method, you had to call `setStorable()` in JavaScript code on every action that called the Apex method. For API version of 44.0 or higher, you can mark the Apex method as storable (cacheable) and get rid of any `setStorable()` calls in JavaScript code. The Apex annotation approach is better because it centralizes your caching notation for a method in the Apex class.

Call `setStorable()` on an action in JavaScript code, as follows.

```
action.setStorable();
```

The `setStorable` function takes an optional argument, which is a configuration map of key-value pairs representing the storage options and values to set. You can only set the following property:

ignoreExisting

Set to `true` to bypass the cache. The default value is `false`.

This property is useful when you know that any cached data is invalid, such as after a record modification. This property should be used rarely because it explicitly defeats caching.

To set the storage options for the action response, pass this configuration map into `setStorable (configObj)`.

IN THIS SECTION:

[Lifecycle of Storable Actions](#)

This image describes the sequence of callback execution for storable actions.

[Enable Storable Actions in an Application](#)

Storable actions are automatically configured in Lightning Experience and the Salesforce mobile app. To use storable actions in a standalone app (`.app` resource), you must configure client-side storage for cached action responses.

[Storage Service Adapters](#)

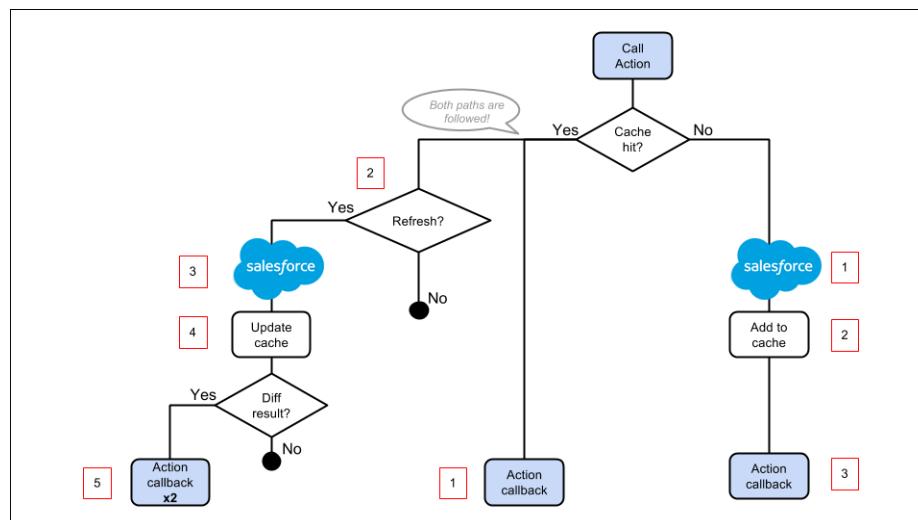
The Storage Service supports multiple implementations of storage and selects an adapter at runtime based on browser support and specified characteristics of persistence and security. Storage can be persistent and secure. With persistent storage, cached data is preserved between user sessions in the browser. With secure storage, cached data is encrypted.

Lifecycle of Storable Actions

This image describes the sequence of callback execution for storable actions.

 **Note:** An action might have its callback invoked more than once:

- First with the cached response, if it's in storage.
- Second with updated data from the server, if the stored response has exceeded the time to refresh entries.



Cache Miss

If the action is not a cache hit as it doesn't match a storage entry:

1. The action is sent to the server-side controller.
2. If the response is `SUCCESS`, the response is added to storage.
3. The callback in the client-side controller is executed.

Cache Hit

If the action is a cache hit as it matches a storage entry:

1. The callback in the client-side controller is executed with the cached action response.
2. If the response has been cached for longer than the refresh time, the storage entry is refreshed.

When an application enables storables actions, a refresh time is configured. The refresh time is the duration in seconds before an entry is refreshed in storage. The refresh time is automatically configured in Lightning Experience and the Salesforce mobile app.

3. The action is sent to the server-side controller.
4. If the response is `SUCCESS`, the response is added to storage.
5. If the refreshed response is different from the cached response, the callback in the client-side controller is executed for a second time.

SEE ALSO:

[Storable Actions](#)

[Enable Storable Actions in an Application](#)

Enable Storable Actions in an Application

Storable actions are automatically configured in Lightning Experience and the Salesforce mobile app. To use storables actions in a standalone app (.app resource), you must configure client-side storage for cached action responses.

To configure client-side storage for your standalone app, use `<auraStorage:init>` in the `auraPreInitBlock` attribute of your application's template. For example:

```
<aura:component isTemplate="true" extends="aura:template">
    <aura:set attribute="auraPreInitBlock">
        <auraStorage:init
            name="actions"
            persistent="false"
            secure="true"
            maxSize="1024"
            defaultExpiration="900"
            defaultAutoRefreshInterval="30" />
    </aura:set>
</aura:component>
```

name

The storage name must be `actions`. Storable actions are the only currently supported type of storage.

persistent

Set to `true` to preserve cached data between user sessions in the browser.

secure

Set to `true` to encrypt cached data.

maxsize

The maximum size in KB of the storage.

defaultExpiration

The duration in seconds that an entry is retained in storage.

defaultAutoRefreshInterval

The duration in seconds before an entry is refreshed in storage.

Storable actions use the Storage Service. The Storage Service supports multiple implementations of storage and selects an adapter at runtime based on browser support and specified characteristics of persistence and security.

SEE ALSO:

[Storage Service Adapters](#)

Storage Service Adapters

The Storage Service supports multiple implementations of storage and selects an adapter at runtime based on browser support and specified characteristics of persistence and security. Storage can be persistent and secure. With persistent storage, cached data is preserved between user sessions in the browser. With secure storage, cached data is encrypted.

| Storage Adapter Name | Persistent | Secure |
|----------------------|--------------------|--------------------|
| IndexedDB | <code>true</code> | <code>false</code> |
| Memory | <code>false</code> | <code>true</code> |

IndexedDB

(Persistent but not secure) Provides access to an API for client-side storage and search of structured data. For more information, see the [Indexed Database API](#).

Memory

(Not persistent but secure) Provides access to JavaScript memory for caching data. The stored cache persists only per browser page. Browsing to a new page resets the cache.

The Storage Service selects a storage adapter on your behalf that matches the persistent and secure options you specify when initializing the service. For example, if you request a persistent and insecure storage service, the Storage Service returns the IndexedDB storage if the browser supports it.

Abortable Actions

Mark an action as abortable to make it potentially abortable while it's queued to be sent to the server. An abortable action in the queue is not sent to the server if the component that created the action is no longer valid, that is `cmp.isValid() == false`. A component is automatically destroyed and marked invalid by the framework when it is unrendered.



Note: We recommend that you only use abortable actions for read-only operations as they are not guaranteed to be sent to the server.

An abortable action is sent to the server and executed normally unless the component that created the action is invalid before the action is sent to the server.

A non-abortable action is always sent to the server and can't be aborted in the queue.

If an action response returns from the server and the associated component is now invalid, the logic has been executed on the server but the action callback isn't executed. This is true whether or not the action is marked as abortable.

Marking an Action as Abortable

Mark a server-side action as abortable by using the `setAbortable()` method on the `Action` object in JavaScript. For example:

```
var action = cmp.get("c.serverEcho");
action.setAbortable();
```

SEE ALSO:

- [Creating Server-Side Logic with Controllers](#)
- [Queueing of Server-Side Actions](#)
- [Calling a Server-Side Action](#)

Working with Salesforce Records

It's easy to work with your Salesforce records in Apex.

The term `sObject` refers to any object that can be stored in Lightning Platform. This could be a standard object, such as `Account`, or a custom object that you create, such as a `Merchandise` object.

An `sObject` variable represents a row of data, also known as a record. To work with an object in Apex, declare it using the SOAP API name of the object. For example:

```
Account a = new Account();
MyCustomObject__c co = new MyCustomObject__c();
```

For more information on working on records with Apex, see [Working with Data in Apex](#).

This example controller persists an updated `Account` record. Note that the `update` method has the `@AuraEnabled` annotation, which enables it to be called as a server-side controller action.

```
public with sharing class AccountController {
    @AuraEnabled
    public static void updateAnnualRevenue(String accountId, Decimal annualRevenue) {
        Account acct = [SELECT Id, Name, BillingCity FROM Account WHERE Id = :accountId];
        acct.AnnualRevenue = annualRevenue;
        // Perform isAccessible() and isUpdateable() checks here
        update acct;
    }
}
```

For an example of calling Apex code from JavaScript code, see the [Quick Start](#) on page 8.

Loading Record Data from a Standard Object

Load records from a standard object in a server-side controller. The following server-side controller has methods that return a list of opportunity records and an individual opportunity record.

```
public with sharing class OpportunityController {
    @AuraEnabled
    public static List<Opportunity> getOpportunities() {
        List<Opportunity> opportunities =
            [SELECT Id, Name, CloseDate FROM Opportunity];
        return opportunities;
    }

    @AuraEnabled
    public static Opportunity getOpportunity(Id id) {
        Opportunity opportunity = [
            SELECT Id, Account.Name, Name, CloseDate,
                Owner.Name, Amount, Description, StageName
            FROM Opportunity
            WHERE Id = :id
        ];
        // Perform isAccessible() check here
        return opportunity;
    }
}
```

This example component uses the previous server-side controller to display a list of opportunity records when you press a button.

```
<aura:component controller="OpportunityController">
    <aura:attribute name="opportunities" type="Opportunity[]"/>

    <ui:button label="Get Opportunities" press="{!c.getOpps}" />
    <aura:iteration var="opportunity" items="{!v.opportunities}">
        <p>{!opportunity.Name} : {!opportunity.CloseDate}</p>
    </aura:iteration>
</aura:component>
```

When you press the button, the following client-side controller calls the `getOpportunities()` server-side controller and sets the `opportunities` attribute on the component. For more information about calling server-side controller methods, see [Calling a Server-Side Action](#) on page 388.

```
({
    getOpps: function(cmp) {
        var action = cmp.get("c.getOpportunities");
        action.setCallback(this, function(response) {
            var state = response.getState();
            if (state === "SUCCESS") {
                cmp.set("v.opportunities", response.getReturnValue());
            }
        });
        $A.enqueueAction(action);
    }
})
```

 **Note:** To load record data during component initialization, use the `init` handler.

Loading Record Data from a Custom Object

Load record data using an Apex controller and setting the data on a component attribute. This server-side controller returns records on a custom object `myObj__c`.

```
public with sharing class MyObjController {  
  
    @AuraEnabled  
    public static List<MyObj__c> getMyObjects() {  
  
        // Perform isAccessible() checks here  
        return [SELECT Id, Name, myField__c FROM MyObj__c];  
    }  
}
```

This example component uses the previous controller to display a list of records from the `myObj__c` custom object.

```
<aura:component controller="MyObjController">  
    <aura:attribute name="myObjects" type="namespace.MyObj__c[]" />  
    <aura:iteration items="{!v.myObjects}" var="obj">  
        {!obj.Name}, {!obj.namespace__myField__c}  
    </aura:iteration>  
</aura:component>
```

This client-side controller sets the `myObjects` component attribute with the record data by calling the `getMyObjects()` method in the server-side controller. This step can also be done during component initialization using the `init` handler.

```
getMyObjects: function(cmp){  
    var action = cmp.get("c.getMyObjects");  
    action.setCallback(this, function(response) {  
        var state = response.getState();  
        if (state === "SUCCESS") {  
            cmp.set("v.myObjects", response.getReturnValue());  
        }  
    });  
    $A.enqueueAction(action);  
}
```

For an example on loading and updating records using controllers, see the [Quick Start](#) on page 8.

IN THIS SECTION:

[CRUD and Field-Level Security \(FLS\)](#)

Aura components don't automatically enforce CRUD and FLS when you reference objects or retrieve the objects from an Apex controller. This means that the framework continues to display records and fields for which users don't have CRUD access and FLS visibility. You must manually enforce CRUD and FLS in your Apex controllers.

[Saving Records](#)

You can take advantage of the built-in create and edit record pages in Salesforce for Android, iOS, and mobile web to create or edit records via an Aura component.

Deleting Records

You can delete records via an Aura component to remove them from both the view and database.

SEE ALSO:

[CRUD and Field-Level Security \(FLS\)](#)

CRUD and Field-Level Security (FLS)

Aura components don't automatically enforce CRUD and FLS when you reference objects or retrieve the objects from an Apex controller. This means that the framework continues to display records and fields for which users don't have CRUD access and FLS visibility. You must manually enforce CRUD and FLS in your Apex controllers.

For example, including the `with sharing` keyword in an Apex controller ensures that users see only the records they have access to in an Aura component. Additionally, you must explicitly check for `isAccessible()`, `isCreateable()`, `isDeletable()`, and `isUpdateable()` prior to performing operations on records or objects.

This example shows the recommended way to perform an operation on a custom expense object.

```
public with sharing class ExpenseController {

    // ns refers to namespace; leave out ns__ if not needed
    // This method is vulnerable.
    @AuraEnabled
    public static List<ns__Expense__c> get_UNSAFE_Expenses() {
        return [SELECT Id, Name, ns__Amount__c, ns__Client__c, ns__Date__c,
                ns__Reimbursed__c, CreatedDate FROM ns__Expense__c];
    }

    // This method is recommended.
    @AuraEnabled
    public static List<ns__Expense__c> getExpenses() {
        String [] expenseAccessFields = new String [] { 'Id',
                                                       'Name',
                                                       'ns__Amount__c',
                                                       'ns__Client__c',
                                                       'ns__Date__c',
                                                       'ns__Reimbursed__c',
                                                       'CreatedDate'
        };
    }

    // Obtain the field name/token map for the Expense object
    Map<String, Schema.SObjectField> m = Schema.SObjectType.ns__Expense__c.fields.getMap();

    for (String fieldToCheck : expenseAccessFields) {

        // Check if the user has access to view field
        if (!m.get(fieldToCheck).getDescribe().isAccessible()) {

            // Pass error to client
            throw new System.NoAccessException();
        }
    }
}
```

```

        }

        // Query the object safely
        return [SELECT Id, Name, ns__Amount__c, ns__Client__c, ns__Date__c,
            ns__Reimbursed__c, CreatedDate FROM ns__Expense__c];
    }
}

```

 **Note:** For more information, see the articles on [Enforcing CRUD and FLS](#) and [Lightning Security](#).

Saving Records

You can take advantage of the built-in create and edit record pages in Salesforce for Android, iOS, and mobile web to create or edit records via an Aura component.

The following component contains a button that calls a client-side controller to display the edit record page.

```
<aura:component>
    <lightning:button label="Edit Record" onclick="{!c.edit}" />
</aura:component>
```

The client-side controller fires the `force:recordEdit` event, which displays the edit record page for a given contact ID. For this event to be handled correctly, the component must be included in Salesforce for Android, iOS, and mobile web.

```
edit : function(component, event, helper) {
    var editRecordEvent = $A.get("e.force:editRecord");
    editRecordEvent.setParams({
        "recordId": component.get("v.contact.Id")
    });
    editRecordEvent.fire();
}
```

Records updated using the `force:recordEdit` event are persisted by default.

Saving Records using an Aura Component

Alternatively, you might have an Aura component that provides a custom form for users to add a record. To save the new record, wire up a client-side controller to an Apex controller. The following list shows how you can persist a record via a component and Apex controller.

 **Note:** If you create a custom form to handle record updates, you must provide your own field validation.

Create an Apex controller to save your updates with the `upsert` operation. The following example is an Apex controller for upserting record data.

```
@AuraEnabled
public static Expense__c saveExpense(Expense__c expense) {
    // Perform isUpdateable() check here
    upsert expense;
    return expense;
}
```

Call a client-side controller from your component. For example, `<lightning:button label="Submit" onclick="{!c.createExpense}" />`.

In your client-side controller, provide any field validation and pass the record data to a helper function.

```
createExpense : function(component, event, helper) {
    // Validate form fields
    // Pass form data to a helper function
    var newExpense = component.get("v.newExpense");
    helper.createExpense(component, newExpense);
}
```

In your component helper, get an instance of the server-side controller and set a callback. The following example upserts a record on a custom object. Recall that `setParams()` sets the value of the `expense` argument on the server-side controller's `saveExpense()` method.

```
createExpense: function(component, expense) {
    //Save the expense and update the view
    this.upsertExpense(component, expense, function(a) {
        var expenses = component.get("v.expenses");
        expenses.push(a.getReturnValue());
        component.set("v.expenses", expenses);
    });
},
upsertExpense : function(component, expense, callback) {
    var action = component.get("c.saveExpense");
    action.setParams({
        "expense": expense
    });
    if (callback) {
        action.setCallback(this, callback);
    }
    $A.enqueueAction(action);
}
```

SEE ALSO:

[CRUD and Field-Level Security \(FLS\)](#)

Deleting Records

You can delete records via an Aura component to remove them from both the view and database.

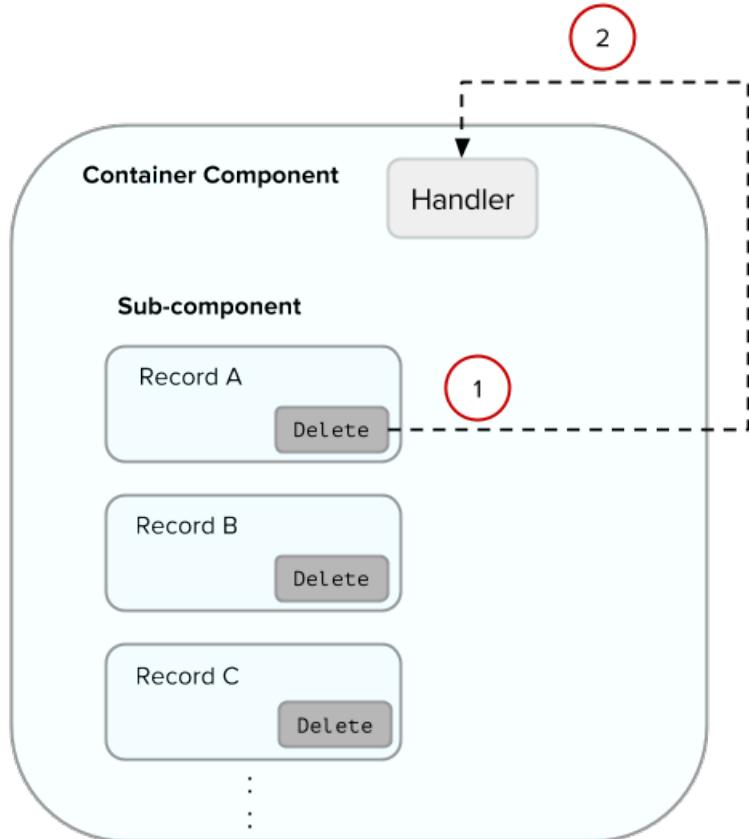
Create an Apex controller to delete a specified record with the `delete` operation. The following Apex controller deletes an expense object record.

```
@AuraEnabled
public static Expense__c deleteExpense(Expense__c expense) {
    // Perform isDeletable() check here
    delete expense;
    return expense;
}
```

Depending on how your components are set up, you might need to create an event to tell another component that a record has been deleted. For example, you have a component that contains a sub-component that is iterated over to display the records. Your

sub-component contains a button (1), which when pressed fires an event that's handled by the container component (2), which deletes the record that's clicked on.

```
<aura:registerEvent name="deleteExpenseItem" type="c:deleteExpenseItem"/>
<lightning:button label="Delete" onclick="{!!c.delete}"/>
```



Create a component event to capture and pass the record that's to be deleted. Name the event `deleteExpenseItem`.

```
<aura:event type="COMPONENT">
    <aura:attribute name="expense" type="Expense__c"/>
</aura:event>
```

Then, pass in the record to be deleted and fire the event in your client-side controller.

```
delete : function(component, evt, helper) {
    var expense = component.get("v.expense");
    var deleteEvent = component.getEvent("deleteExpenseItem");
    deleteEvent.setParams({ "expense": expense }).fire();
}
```

In the container component, include a handler for the event. In this example, `c:expenseList` is the sub-component that displays records.

```
<aura:handler name="deleteExpenseItem" event="c:deleteExpenseItem" action="c:deleteEvent"/>
<aura:iteration items="{!!v.expenses}" var="expense">
```

```
<c:expenseList expense="{!!expense}" />
</aura:iteration>
```

And handle the event in the client-side controller of the container component.

```
deleteEvent : function(component, event, helper) {
    // Call the helper function to delete record and update view
    helper.deleteExpense(component, event.getParam("expense"));
}
```

Finally, in the helper function of the container component, call your Apex controller to delete the record and update the view.

```
deleteExpense : function(component, expense, callback) {
    // Call the Apex controller and update the view in the callback
    var action = component.get("c.deleteExpense");
    action.setParams({
        "expense": expense
    });
    action.setCallback(this, function(response) {
        var state = response.getState();
        if (state === "SUCCESS") {
            // Remove only the deleted expense from view
            var expenses = component.get("v.expenses");
            var items = [];
            for (i = 0; i < expenses.length; i++) {
                if(expenses[i]!==expense) {
                    items.push(expenses[i]);
                }
            }
            component.set("v.expenses", items);
            // Other client-side logic
        }
    });
    $A.enqueueAction(action);
}
```

The helper function calls the Apex controller to delete the record in the database. In the callback function, `component.set("v.expenses", items)` updates the view with the updated array of records.

SEE ALSO:

[CRUD and Field-Level Security \(FLS\)](#)

[Component Events](#)

[Calling a Server-Side Action](#)

Testing Your Apex Code

Before you can upload a managed package, you must write and execute tests for your Apex code to meet minimum code coverage requirements. Also, all tests must run without errors when you upload your package to AppExchange.

To package your application and components that depend on Apex code, the following must be true.

- Unit tests must cover at least 75% of your Apex code, and all of those tests must complete successfully.

Note the following.

- When deploying Apex to a production organization, each unit test in your organization namespace is executed by default.
 - Calls to `System.debug` are not counted as part of Apex code coverage.
 - Test methods and test classes are not counted as part of Apex code coverage.
 - While only 75% of your Apex code must be covered by tests, don't focus on the percentage of code that is covered. Instead, make sure that every use case of your application is covered, including positive and negative cases, as well as bulk and single records. This approach ensures that 75% or more of your code is covered by unit tests.
- Every trigger must have some test coverage.
 - All classes and triggers must compile successfully.

This sample shows an Apex test class for a custom object that's wired up to a component.

```
@isTest
class TestExpenseController {
    static testMethod void test() {
        //Create new expense and insert it into the database
        Expense__c exp = new Expense__c(name='My New Expense',
                                         amount__c=20, client__c='ABC',
                                         reimbursed__c=false, date__c=null);
        ExpenseController.saveExpense(exp);

        //Assert the name field and saved expense
        System.assertEquals('My New Expense',
                           ExpenseController.getExpenses()[0].Name,
                           'Name does not match');
        System.assertEquals(exp, ExpenseController.saveExpense(exp));
    }
}
```

 **Note:** Apex classes must be manually added to your package.

For more information on distributing Apex code, see the [Apex Code Developer's Guide](#).

SEE ALSO:

[Distributing Applications and Components](#)

Making API Calls from Apex

Make API calls from an Apex controller. You can't make Salesforce API calls from JavaScript code.

For security reasons, the Lightning Component framework places restrictions on making API calls from JavaScript code. To call third-party APIs from your component's JavaScript code, add the API endpoint as a CSP Trusted Site.

To call Salesforce APIs, make the API calls from your component's Apex controller. Use a named credential to authenticate to Salesforce.

 **Note:** By security policy, sessions created by Lightning components aren't enabled for API access. This prevents even your Apex code from making API calls to Salesforce. Using a named credential for specific API calls allows you to carefully and selectively bypass this security restriction.

The restrictions on API-enabled sessions aren't accidental. Carefully review any code that uses a named credential to ensure you're not creating a vulnerability.

For information about making API calls from Apex, see the [Apex Developer Guide](#).

SEE ALSO:

[Apex Developer Guide: Named Credentials as Callout Endpoints](#)

[Making API Calls from Components](#)

[Create CSP Trusted Sites to Access Third-Party APIs](#)

[Content Security Policy Overview](#)

Creating Components in Apex

Creating components on the server side in Apex, using the `Cmp.<myNamespace>.<myComponent>` syntax, is deprecated. Use `$A.createComponent()` in client-side JavaScript code instead.

SEE ALSO:

[Dynamically Creating Components](#)

CHAPTER 11 Lightning Data Service

In this chapter ...

- [Loading a Record](#)
- [Saving a Record](#)
- [Creating a Record](#)
- [Deleting a Record](#)
- [Record Changes](#)
- [Errors](#)
- [Considerations](#)
- [Lightning Data Service Example](#)
- [SaveRecordResult](#)

Use Lightning Data Service to load, create, edit, or delete a record in your component without requiring Apex code. Lightning Data Service handles sharing rules and field-level security for you. In addition to not needing Apex, Lightning Data Service improves performance and user interface consistency.

At the simplest level, you can think of Lightning Data Service as the Lightning components version of the Visualforce standard controller. While this statement is an over-simplification, it serves to illustrate a point. Whenever possible, use Lightning Data Service to read and modify Salesforce data in your components.

Data access with Lightning Data Service is simpler than the equivalent using a server-side Apex controller. Read-only access can be entirely declarative in your component's markup. For code that modifies data, your component's JavaScript controller is roughly the same amount of code, and you eliminate the Apex entirely. All your data access code is consolidated into your component, which significantly reduces complexity.

Lightning Data Service provides other benefits aside from the code. It's built on highly efficient local storage that's shared across all components that use it. Records loaded in Lightning Data Service are cached and shared across components.

 **Note:** Working with Lightning Data Service in Lightning Web Components? See the [Lightning Web Components Developer Guide](#).

Components accessing the same record see significant performance improvements, because a record is loaded only once, no matter how many components are using it. Shared records also improve user interface consistency. When one component updates a record, the other components using it are notified, and in most cases, refresh automatically.

Loading a Record

Loading a record is the simplest operation in Lightning Data Service. You can accomplish it entirely in markup.

To load a record using Lightning Data Service, add the `force:recordData` tag to your component and specify:

- The ID of the record to load
- A component attribute to assign the loaded record
- A list of fields to load

 **Note:** Consider using the simpler `lightning:recordForm` component if you don't need custom styling and custom rendering. See <https://developer.salesforce.com/docs/component-library/bundle/lightning:recordForm/documentation>

To specify a list of fields to load, use the `fields` attribute. For example, `fields="Name,BillingCity,BillingState"`.

Alternatively, you can specify a layout using the `layoutType` attribute. All fields on that layout are loaded for the record. The layout depends on the page layout assignment for the profile. For example, if a user using the Marketing User profile is assigned the default account layout, all fields on that layout are available to that user. Layouts are typically modified by administrators, so `layoutType` isn't as flexible as `fields` when you want to request specific fields. Loading record data using `layoutType` allows your component to adapt to layout definitions. Valid values for `layoutType` are `FULL` and `COMPACT`.

To get a field from an object regardless of whether an admin has included it in a layout, use the `fields` attribute and request the field by name. To guarantee that a field is always there for the component, specify the field in addition to getting all the fields on a layout.

`targetRecord` is populated with the current record, containing the fields relevant to the requested `layoutType` or the fields listed in the `fields` attribute. `targetFields` is populated with a simplified view of the loaded record. For example, for the `Name` field, `v.targetRecord.fields.Name.value` is equivalent to `v.targetFields.Name`.

Example: Loading a Record

The following example illustrates the essentials of loading a record using Lightning Data Service. This component can be added to a record home page in the Lightning App Builder, or as a custom action. The record ID is supplied by the implicit `recordId` attribute added by the `force:hasRecordId` interface.

```
ldsLoad cmp

<aura:component
    implements="flexipage:availableForRecordHome, force:lightningQuickActionWithoutHeader,
    force:hasRecordId">

    <aura:attribute name="record" type="Object"/>
    <aura:attribute name="simpleRecord" type="Object"/>
    <aura:attribute name="recordError" type="String"/>

    <force:recordData aura:id="recordLoader"
        recordId="{!v.recordId}"
        targetFields="{!v.simpleRecord}"
        targetError="{!v.recordError}"
        recordUpdated="{!c.handleRecordUpdated}"
    />

    <!-- Display a lightning card with details about the record -->
    <div class="Record Details">
        <lightning:card iconName="standard:account" title="{!v.simpleRecord.Name}" >
            <div class="slds-p-horizontal--small">
                <p class="slds-text-heading--small">
```

```

        <lightning:formattedText title="Billing City"
value="{!!v.simpleRecord.BillingCity}" /></p>
        <p class="slds-text-heading--small">
            <lightning:formattedText title="Billing State"
value="{!!v.simpleRecord.BillingState}" /></p>
        </div>
    </lightning:card>
</div>

<!-- Display Lightning Data Service errors, if any -->
<aura:if isTrue="{!!not(empty(v.recordError))}">
    <div class="recordError">
        {!v.recordError}</div>
</aura:if>
</aura:component>

```

ldsLoadController.js

```

({
    handleRecordUpdated: function(component, event, helper) {
        var eventParams = event.getParams();
        if(eventParams.changeType === "LOADED") {
            // record is loaded (render other component which needs record data value)

            console.log("Record is loaded successfully.");
            console.log("You loaded a record in " +
                component.get("v.simpleRecord.Industry"));
        } else if(eventParams.changeType === "CHANGED") {
            // record is changed
        } else if(eventParams.changeType === "REMOVED") {
            // record is deleted
        } else if(eventParams.changeType === "ERROR") {
            // there's an error while loading, saving, or deleting the record
        }
    }
})

```

When the record loads or updates, to access the record fields in the JavaScript controller, use the `component.get("v.simpleRecord.fieldName")` syntax.

`force:recordData` loads data asynchronously by design since it may go to the server to retrieve data. To track when the record is loaded or changed, use the `recordUpdated` event as shown in the previous example. Alternatively, you can place a change handler on the attribute provided to `targetRecord` or `targetFields`.

SEE ALSO:

[Configure Components for Lightning Experience Record Pages](#)

[Configure Components for Record-Specific Actions](#)

Saving a Record

To save a record using Lightning Data Service, call `saveRecord` on the `force:recordData` component, and pass in a callback function to be invoked after the save operation completes.

The Lightning Data Service save operation is used in two cases.

- To save changes to an existing record
- To create and save a new record

To save changes to an existing record, load the record in EDIT mode and call `saveRecord` on the `force:recordData` component.

To save a new record, and thus create it, create the record from a record template, as described in [Creating a Record](#). Then call `saveRecord` on the `force:recordData` component.

Load a Record in EDIT Mode

To load a record that might be updated, set the `force:recordData` tag's `mode` attribute to "EDIT". Other than explicitly setting the `mode`, loading a record for editing is the same as loading it for any other purpose.

 **Note:** Since Lightning Data Service records are shared across multiple components, loading records load the component with a copy of the record instead of a direct reference. If a component loads a record in VIEW mode, Lightning Data Service will automatically overwrite that copy with a newer copy of the record when the record is changed. If a record is loaded in EDIT mode, the record is not updated when the record is changed. This prevents unsaved changes from appearing in components that reference the record while the record is being edited, and prevents any edits in progress from being overwritten. Notifications are still sent in both modes.

Call `saveRecord` to Save Record Changes

To perform the save operation, call `saveRecord` on the `force:recordData` component from the appropriate controller action handler. `saveRecord` takes one argument—a callback function to be invoked when the operation completes. This callback function receives a `SaveRecordResult` as its only parameter. `SaveRecordResult` includes a `state` attribute that indicates success or error, and other details you can use to handle the result of the operation.

 **Example: Saving a Record**

The following example illustrates the essentials of saving a record using Lightning Data Service. It's intended for use on a record page. The record ID is supplied by the implicit `recordId` attribute added by the `force:hasRecordId` interface.

`ldsSave.cmp`

```
<aura:component implements="flexipage:availableForRecordHome, force:hasRecordId">

    <aura:attribute name="record" type="Object"/>
    <aura:attribute name="simpleRecord" type="Object"/>
    <aura:attribute name="recordError" type="String"/>

    <force:recordData aura:id="recordHandler"
        recordId="{!v.recordId}"
        layoutType="FULL"
        targetRecord="{!v.record}"
        targetFields="{!v.simpleRecord}"
        targetError="{!v.recordError}"
        mode="EDIT"
        recordUpdated="{!!c.handleRecordUpdated}"
    />

    <!-- Display a lightning card with details about the record -->
    <div class="Record Details">
```

```

<lightning:card iconName="standard:account" title="{!v.simpleRecord.Name}" >
    <div class="slds-p-horizontal--small">
        <p class="slds-text-heading--small">
            <lightning:formattedText title="Billing State"
value="{!!v.simpleRecord.BillingState}" /></p>
        <p class="slds-text-heading--small">
            <lightning:formattedText title="Billing City"
value="{!!v.simpleRecord.BillingCity}" /></p>
    </div>
</lightning:card>
</div>

<!-- Display an editing form -->
<div class="Record Details">
    <lightning:card iconName="action:edit" title="Edit Account">
        <div class="slds-p-horizontal--small">
            <lightning:input label="Account Name" value="{!!v.simpleRecord.Name}" />

            <br/>
            <lightning:button label="Save Account" variant="brand"
onclick="{!!c.handleSaveRecord}" />
        </div>
    </lightning:card>
</div>

<!-- Display Lightning Data Service errors, if any -->
<aura:if isTrue=" {!not(empty(v.recordError)) } ">
    <div class="recordError">
        {!v.recordError}</div>
    </aura:if>
</aura:component>

```

 **Note:** If you're using this component with an object that has a first and last name, such as contacts, create a separate lightning:input component for `{!v.simpleRecord.FirstName}` and `{!v.simpleRecord.LastName}`.

This component loads a record using `force:recordData` set to EDIT mode, and provides a form for editing record values. (In this simple example, just the record name field.)

ldsSaveController.js

```

({
    handleSaveRecord: function(component, event, helper) {
        component.find("recordHandler").saveRecord($A.getCallback(function(saveResult)
{
    // NOTE: If you want a specific behavior(an action or UI behavior) when
this action is successful
    // then handle that in a callback (generic logic when record is changed
should be handled in recordUpdated event handler)
    if (saveResult.state === "SUCCESS" || saveResult.state === "DRAFT") {
        // handle component related logic in event handler
    } else if (saveResult.state === "INCOMPLETE") {
        console.log("User is offline, device doesn't support drafts.");
    } else if (saveResult.state === "ERROR") {
        console.log('Problem saving record, error: ' +

```

```
JSON.stringify(saveResult.error));
    } else {
        console.log('Unknown problem, state: ' + saveResult.state + ', error:
' + JSON.stringify(saveResult.error));
    }
}),
},
/**
 * Control the component behavior here when record is changed (via any component)
 */
handleRecordUpdated: function(component, event, helper) {
    var eventParams = event.getParams();
    if(eventParams.changeType === "CHANGED") {
        // get the fields that changed for this record
        var changedFields = eventParams.changedFields;
        console.log('Fields that are changed: ' + JSON.stringify(changedFields));

        // record is changed, so refresh the component (or other component logic)

        var resultsToast = $A.get("e.force:showToast");
        resultsToast.setParams({
            "title": "Saved",
            "message": "The record was updated."
        });
        resultsToast.fire();

    } else if(eventParams.changeType === "LOADED") {
        // record is loaded in the cache
    } else if(eventParams.changeType === "REMOVED") {
        // record is deleted and removed from the cache
    } else if(eventParams.changeType === "ERROR") {
        // there's an error while loading, saving or deleting the record
    }
}
})
```

The `handleSaveRecord` action here is a minimal version. There's no form validation or real error handling. Whatever is entered in the form is attempted to be saved to the record.

SEE ALSO:

[SaveRecordResult](#)

[Configure Components for Lightning Experience Record Pages](#)

[Configure Components for Record-Specific Actions](#)

Creating a Record

To create a record using Lightning Data Service, declare `force:recordData` without assigning a `recordId`. Next, load a record template by calling the `getNewRecord` function on `force:recordData`. Finally, apply values to the new record, and save the record by calling the `saveRecord` function on `force:recordData`.

1. Call `getNewRecord` to create an empty record from a record template. You can use this record as the backing store for a form or otherwise have its values set to data intended to be saved.
2. Call `saveRecord` to commit the record. This is described in [Saving a Record](#).

Create an Empty Record from a Record Template

To create an empty record from a record template, you can't set a `recordId` on the `force:recordData` tag. Without a `recordId`, Lightning Data Service doesn't load an existing record.

In your component's `init` or another handler, call the `getNewRecord` on `force:recordData`. `getNewRecord` takes the following arguments.

| Attribute Name | Type | Description |
|----------------------------|----------|---|
| <code>objectApiName</code> | String | The object API name for the new record. |
| <code>recordTypeId</code> | String | The 18 character ID of the record type for the new record. If not specified, the default record type for the object is used, as defined in the user's profile. |
| <code>skipCache</code> | Boolean | Whether to load the record template from the server instead of the client-side Lightning Data Service cache. Defaults to <code>false</code> . |
| <code>callback</code> | Function | A function invoked after the empty record is created. This function receives no arguments. |

`getNewRecord` doesn't return a result. It simply prepares an empty record and assigns it to the `targetRecord` attribute.

Example: Creating a Record

The following example illustrates the essentials of creating a record using Lightning Data Service. This example is intended to be added to an account record Lightning page.

`ldsCreate cmp`

```
<aura:component implements="flexipage:availableForRecordHome, force:hasRecordId">

    <aura:attribute name="newContact" type="Object"/>
    <aura:attribute name="simpleNewContact" type="Object"/>
    <aura:attribute name="newContactError" type="String"/>

    <aura:handler name="init" value="{!this}" action=" {!c.doInit} "/>

    <force:recordData aura:id="contactRecordCreator"
        layoutType="FULL"
        targetRecord=" {!v.newContact}"
        targetFields=" {!v.simpleNewContact}"
        targetError=" {!v.newContactError} " />

    <!-- Display the new contact form -->
    <div class="Create Contact">
        <lightning:card iconName="action:new_contact" title="Create Contact">
            <div class="slds-p-horizontal--small">
```

```

        <lightning:input aura:id="contactField" label="First Name"
value="{!!v.simpleNewContact.FirstName}" />
        <lightning:input aura:id="contactField" label="Last Name"
value="{!!v.simpleNewContact.LastName}" />
        <lightning:input aura:id="contactField" label="Title"
value="{!!v.simpleNewContact.Title}" />
        <br/>
        <lightning:button label="Save Contact" variant="brand"
onclick="{!!c.handleSaveContact}" />
    </div>
</lightning:card>
</div>

<!-- Display Lightning Data Service errors -->
<aura:if isTrue="{!!not(empty(v.newContactError))}">
    <div class="recordError">
        {!v.newContactError}</div>
</aura:if>

</aura:component>

```

This component doesn't set the `recordId` attribute of `force:recordData`. This tells Lightning Data Service to expect a new record. Here, that's created in the component's `init` handler.

`ldsCreateController.js`

```

({
    doInit: function(component, event, helper) {
        // Prepare a new record from template
        component.find("contactRecordCreator").getNewRecord(
            "Contact", // sObject type (objectApiName)
            null,       // recordTypeId
            false,      // skip cache?
            $A.getCallback(function() {
                var rec = component.get("v.newContact");
                var error = component.get("v.newContactError");
                if(error || (rec === null)) {
                    console.log("Error initializing record template: " + error);
                    return;
                }
                console.log("Record template initialized: " + rec.apiName);
            })
        );
    },

    handleSaveContact: function(component, event, helper) {
        if(helper.validateContactForm(component)) {
            component.set("v.simpleNewContact.AccountId", component.get("v.recordId"));

            component.find("contactRecordCreator").saveRecord(function(saveResult) {
                if (saveResult.state === "SUCCESS" || saveResult.state === "DRAFT") {

                    // record is saved successfully
                    var resultsToast = $A.get("e.force:showToast");
                    resultsToast.setParams({

```

```
        "title": "Saved",
        "message": "The record was saved."
    });
    resultsToast.fire();

} else if (saveResult.state === "INCOMPLETE") {
    // handle the incomplete state
    console.log("User is offline, device doesn't support drafts.");
} else if (saveResult.state === "ERROR") {
    // handle the error state
    console.log('Problem saving contact, error: ' +
JSON.stringify(saveResult.error));
} else {
    console.log('Unknown problem, state: ' + saveResult.state + ', ' +
error: ' + JSON.stringify(saveResult.error));
}
});
```

The `doInit` init handler calls `getNewRecord()` on the `force:recordData` component, passing in a simple callback handler. This call returns a `Record` object to create an empty contact record, which is used by the contact form in the component's markup.

 **Note:** The callback passed to `getNewRecord()` must be wrapped in `$A.getCallback()` to ensure correct access context when the callback is invoked. If the callback is passed in without being wrapped in `$A.getCallback()`, any attempt to access private attributes of your component results in access check failures.

Even if you're not accessing private attributes, it's a best practice to always wrap the callback function for `getNewRecord()` in `$A.getCallback()`. Never mix (contexts), never worry.

The `handleSaveContact` handler is called when the **Save Contact** button is clicked. It's a straightforward application of saving the contact, as described in [Saving a Record](#), and then updating the user interface.

 **Note:** The helper function, `validateContactForm`, isn't shown. It simply validates the form values. For an example of this validation, see [Lightning Data Service Example](#).

SEE ALSO:

[Saving a Record](#)

[Configure Components for Lightning Experience Record Pages](#)

[Configure Components for Record-Specific Actions](#)

[Controlling Access](#)

Deleting a Record

To delete a record using Lightning Data Service, call `deleteRecord` on the `force:recordData` component, and pass in a callback function to be invoked after the delete operation completes.

Delete operations with Lightning Data Service are straightforward. The `force:recordData` tag can include minimal details. If you don't need any record data, set the `fields` attribute to just `Id`. If you know that the only operation is a delete, any `mode` can be used.

To perform the delete operation, call `deleteRecord` on the `force:recordData` component from the appropriate controller action handler. `deleteRecord` takes one argument, a callback function to be invoked when the operation completes. This callback function receives a `SaveRecordResult` as its only parameter. `SaveRecordResult` includes a `state` attribute that indicates success or error, and other details you can use to handle the result of the operation.

Example: Deleting a Record

The following example illustrates the essentials of deleting a record using Lightning Data Service. This component adds a **Delete Record** button to a record page, which deletes the record being displayed. The record ID is supplied by the implicit `recordId` attribute added by the `force:hasRecordId` interface.

`ldsDelete.cmp`

```
<aura:component implements="flexipage:availableForRecordHome, force:hasRecordId">

    <aura:attribute name="recordError" type="String" access="private"/>

    <force:recordData aura:id="recordHandler"
        recordId="{!v.recordId}"
        fields="Id"
        targetError="{!v.recordError}"
        recordUpdated="{!!c.handleRecordUpdated}" />

    <!-- Display the delete record form -->
    <div class="Delete Record">
        <lightning:card iconName="action:delete" title="Delete Record">
            <div class="slds-p-horizontal--small">
                <lightning:button label="Delete Record" variant="destructive"
                    onclick="{!!c.handleDeleteRecord}"/>
            </div>
        </lightning:card>
    </div>

    <!-- Display Lightning Data Service errors, if any -->
    <aura:if isTrue="{!!not(empty(v.recordError))}">
        <div class="recordError">
            {!v.recordError}</div>
    </aura:if>
</aura:component>
```

Notice that the `force:recordData` tag includes only the `recordId` and a nearly empty `fields` list—the absolute minimum required. If you want to display record values in the user interface, for example, as part of a confirmation message, define the `force:recordData` tag as you would for a load operation instead of this minimal delete example.

`ldsDeleteController.js`

```
{
    handleDeleteRecord: function(component, event, helper) {
        component.find("recordHandler").deleteRecord($A.getCallback(function(deleteResult) {
            // NOTE: If you want a specific behavior(an action or UI behavior) when
            this action is successful
        }));
    }
}
```

```

        // then handle that in a callback (generic logic when record is changed
        // should be handled in recordUpdated event handler)
        if (deleteResult.state === "SUCCESS" || deleteResult.state === "DRAFT") {

            // record is deleted
            console.log("Record is deleted.");
        } else if (deleteResult.state === "INCOMPLETE") {
            console.log("User is offline, device doesn't support drafts.");
        } else if (deleteResult.state === "ERROR") {
            console.log('Problem deleting record, error: ' +
JSON.stringify(deleteResult.error));
        } else {
            console.log('Unknown problem, state: ' + deleteResult.state + ', error:
' + JSON.stringify(deleteResult.error));
        }
    });

}

/**
 * Control the component behavior here when record is changed (via any component)

*/
handleRecordUpdated: function(component, event, helper) {
    var eventParams = event.getParams();
    if(eventParams.changeType === "CHANGED") {
        // record is changed
    } else if(eventParams.changeType === "LOADED") {
        // record is loaded in the cache
    } else if(eventParams.changeType === "REMOVED") {
        // record is deleted, show a toast UI message
        var resultsToast = $A.get("e.force:showToast");
        resultsToast.setParams({
            "title": "Deleted",
            "message": "The record was deleted."
        });
        resultsToast.fire();

    } else if(eventParams.changeType === "ERROR") {
        // there's an error while loading, saving, or deleting the record
    }
}
}

```

When the record is deleted, navigate away from the record page. Otherwise, you see a “record not found” error when the component refreshes. Here the controller uses the `objectApiName` property in the `SaveRecordResult` provided to the callback function, and navigates to the object home page.

SEE ALSO:

[SaveRecordResult](#)

[Configure Components for Lightning Experience Record Pages](#)

[Configure Components for Record-Specific Actions](#)

Record Changes

To perform tasks beyond rerendering the record when the record changes, handle the `recordUpdated` event. You can handle record loaded, updated, and deleted changes, applying different actions to each change type.

If a component performs logic that is record data specific, it must run that logic again when the record changes. A common example is a business process in which the actions that apply to a record change depending on the record's values. For example, different actions apply to opportunities at different stages of the sales cycle.

 **Note:** Lightning Data Service notifies listeners about data changes only if the changed fields are the same as in the listener's fields or layout.

 **Example:** Declare that your component handles the `recordUpdated` event.

```
<force:recordData aura:id="forceRecord"
    recordId="{!!v.recordId}"
    layoutType="FULL"
    targetRecord="{!!v._record}"
    targetFields="{!!v.simpleRecord}"
    targetError="{!!v._error}"
    recordUpdated="{!!c.recordUpdated}" />
```

Implement an action handler that handles the change.

```
({
  recordUpdated: function(component, event, helper) {

    var changeType = event.getParams().changeType;

    if (changeType === "ERROR") { /* handle error; do this first! */ }
    else if (changeType === "LOADED") { /* handle record load */ }
    else if (changeType === "REMOVED") { /* handle record removal */ }
    else if (changeType === "CHANGED") { /* handle record change */ }
  })
})
```

When loading a record in edit mode, the record is not automatically updated to prevent edits currently in progress from being overwritten. To update the record, use the `reloadRecord` method in the action handler.

```
<force:recordData aura:id="forceRecord"
    recordId="{!!v.recordId}"
    layoutType="FULL"
    targetRecord="{!!v._record}"
    targetFields="{!!v.simpleRecord}"
    targetError="{!!v._error}"
    mode="EDIT"
    recordUpdated="{!!c.recordUpdated}" />

({
  recordUpdated : function(component, event, helper) {

    var changeType = event.getParams().changeType;

    if (changeType === "ERROR") { /* handle error; do this first! */ }
    else if (changeType === "LOADED") { /* handle record load */ }
```

```

        else if (changeType === "REMOVED") { /* handle record removal */ }
        else if (changeType === "CHANGED") {
            /* handle record change; reloadRecord will cause you to lose your current record,
            including any changes you've made */
            component.find("forceRecord").reloadRecord();
        }
    )
}
)

```

Errors

To act when an error occurs, handle the `recordUpdated` event and handle the case where the `changeType` is "ERROR".

 **Example:** Declare that your component handles the `recordUpdated` event.

```
<force:recordData aura:id="forceRecord"
    recordId="{!!v.recordId}"
    layoutType="FULL"
    targetRecord="{!!v._record}"
    targetFields="{!!v.simpleRecord}"
    targetError="{!!v._error}"
    recordUpdated="{!!c.recordUpdated}" />
```

Implement an action handler that handles the error.

```
{
    recordUpdated: function(component, event, helper) {
        var changeType = event.getParams().changeType;

        if (changeType === "ERROR") { /* handle error; do this first! */ }
        else if (changeType === "LOADED") { /* handle record load */ }
        else if (changeType === "REMOVED") { /* handle record removal */ }
        else if (changeType === "CHANGED") { /* handle record change */ }
    }
}
```

If an error occurs when the record begins to load, `targetError` is set to a localized error message. An error occurs if:

- Input is invalid because of an invalid attribute value, or combination of attribute values. For example, an invalid `recordId`, or omitting both the `layoutType` and the `fields` attributes.
- The record isn't in the cache and the server is unreachable (offline).

If the record becomes inaccessible on the server, the `recordUpdated` event is fired with `changeType` set to "REMOVED".

No error is set on `targetError`, since records becoming inaccessible is sometimes the expected outcome of an operation.

For example, after lead convert the lead record becomes inaccessible.

Records can become inaccessible for the following reasons.

- Record or entity sharing or visibility settings
- Record or entity being deleted

When the record becomes inaccessible on the server, the record's JavaScript object assigned to `targetRecord` is unchanged.

Considerations

Lightning Data Service is powerful and simple to use. However, it's not a complete replacement for writing your own data access code. Here are some considerations to keep in mind when using it.

Lightning Data Service is available in the following containers:

- Lightning Experience
- Salesforce app
- Lightning Communities
- Lightning Out
- Lightning Components for Visualforce
- Standalone Lightning apps
- Lightning for Gmail
- Lightning for Outlook

Lightning Data Service supports primitive DML operations—create, read, update, and delete. It operates on one record at a time, which you retrieve or modify using the record ID. Lightning Data Service supports spanned fields with a maximum depth of five levels. Support for working with collections of records or for querying for a record by anything other than the record ID isn't available. If you must support higher-level operations or multiple operations in one transaction, use standard `@AuraEnabled` Apex methods.

Lightning Data Service shared data storage provides notifications to all components that use a record whenever a component changes that record. It doesn't notify components if that record is changed on the server, for example, if someone else modifies it. Records changed on the server aren't updated locally until they're reloaded. Lightning Data Service notifies listeners about data changes only if the changed fields are the same as in the listener's fields or layout.

Supported Objects

Lightning Data Service supports custom objects and the following.

- Account
- AccountTeamMember
- Asset
- AssetRelationship
- AssignedResource
- AttachedContentNote
- BusinessAccount
- Campaign
- CampaignMember
- CareBarrier
- CareBarrierType
- Case
- Contact
- ContactRequest
- ContentDocument
- ContentNote

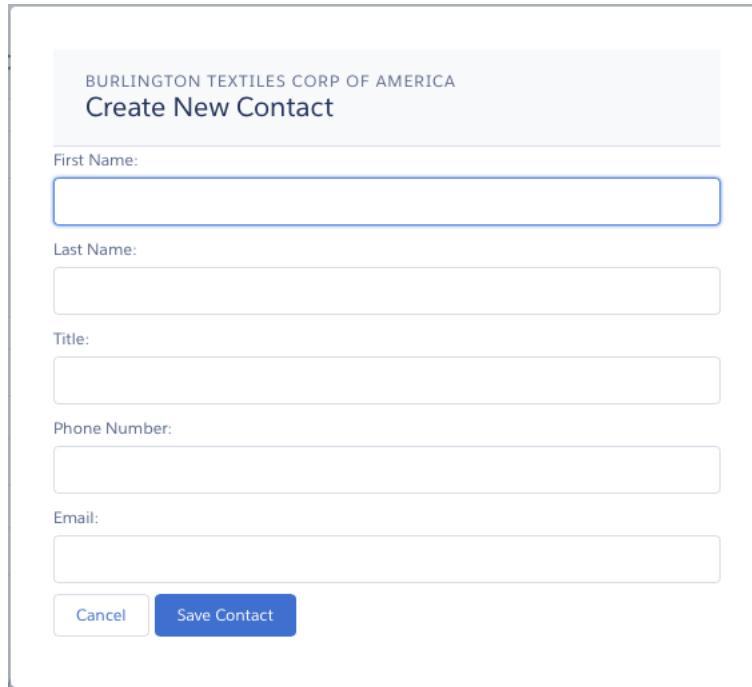
- ContentVersion
- ContentWorkspace
- Contract
- ContractContactRole
- ContractLineItem
- Custom Object
- Entitlement
- EnvironmentHubMember
- Lead
- LicensingRequest
- MaintenanceAsset
- MaintenancePlan
- MarketingAction
- MarketingResource
- Note
- OperatingHours
- Opportunity
- OpportunityLineItem
- OpportunityTeamMember
- Order
- OrderItem
- PersonAccount
- Pricebook2
- PricebookEntry
- Product2
- Quote
- QuoteDocument
- QuoteLineItem
- ResourceAbsence
- ResourcePreference
- ServiceAppointment
- ServiceContract
- ServiceCrew
- ServiceCrewMember
- ServiceResource
- ServiceResourceCapacity
- ServiceResourceSkill
- ServiceTerritory
- ServiceTerritoryLocation
- ServiceTerritoryMember

- Shipment
- SkillRequirement
- SocialPost
- Tenant
- TimeSheet
- TimeSheetEntry
- TimeSlot
- UsageEntitlement
- UsageEntitlementPeriod
- User
- WorkOrder
- WorkOrderLineItem
- WorkType

Lightning Data Service Example

Here's a longer, more detailed example of using Lightning Data Service to create a Quick Contact action panel.

 **Example:** This example is intended to be added as a Lightning action on the account object. Clicking the action's button on the account layout opens a panel to create a new contact.



BURLINGTON TEXTILES CORP OF AMERICA
Create New Contact

First Name:

Last Name:

Title:

Phone Number:

Email:

Cancel Save Contact

This example is similar to the example provided in [Configure Components for Record-Specific Actions](#). Compare the two examples to better understand the differences between using `@AuraEnabled` Apex controllers and using Lightning Data Service.

ldsQuickContact.cmp

```

<aura:component implements="force:lightningQuickActionWithoutHeader, force:hasRecordId">

    <aura:attribute name="account" type="Object"/>
    <aura:attribute name="simpleAccount" type="Object"/>
    <aura:attribute name="accountError" type="String"/>
    <force:recordData aura:id="accountRecordLoader"
        recordId="{!!v.recordId}"
        fields="Name,BillingCity,BillingState"
        targetRecord="{!!v.account}"
        targetFields="{!!v.simpleAccount}"
        targetError="{!!v.accountError}"
    />

    <aura:attribute name="newContact" type="Object" access="private"/>
    <aura:attribute name="simpleNewContact" type="Object" access="private"/>
    <aura:attribute name="newContactError" type="String" access="private"/>
    <force:recordData aura:id="contactRecordCreator"
        layoutType="FULL"
        targetRecord="{!!v.newContact}"
        targetFields="{!!v.simpleNewContact}"
        targetError="{!!v.newContactError}"
    />

    <aura:handler name="init" value="{!!this}" action="{!!c.doInit}"/>

    <!-- Display a header with details about the account -->
    <div class="slds-page-header" role="banner">
        <p class="slds-text-heading_label">{!!v.simpleAccount.Name}</p>
        <h1 class="slds-page-header__title slds-m-right_small
            slds-truncate slds-align-left">Create New Contact</h1>
    </div>

    <!-- Display Lightning Data Service errors, if any -->
    <aura:if isTrue="{!!not(empty(v.accountError))}">
        <div class="recordError">
            <ui:message title="Error" severity="error" closable="true">
                {!!v.accountError}
            </ui:message>
        </div>
    </aura:if>
    <aura:if isTrue="{!!not(empty(v.newContactError))}">
        <div class="recordError">
            <ui:message title="Error" severity="error" closable="true">
                {!!v.newContactError}
            </ui:message>
        </div>
    </aura:if>

    <!-- Display the new contact form -->
    <lightning:input aura:id="contactField" name="firstName" label="First Name"
        value="{!!v.simpleNewContact.FirstName}" required="true"/>

```

```

<lightning:input aura:id="contactField" name="lastname" label="Last Name"
    value="{!v.simpleNewContact.LastName}" required="true"/>

<lightning:input aura:id="contactField" name="title" label="Title"
    value="{!v.simpleNewContact.Title}" />

<lightning:input aura:id="contactField" type="phone" name="phone" label="Phone
Number"
    pattern="^((1?(-?\d{3})-?)?(\d{3}))(-?\d{4})$"
    messageWhenPatternMismatch="The phone number must contain 7, 10,
or 11 digits. Hyphens are optional."
    value="{!v.simpleNewContact.Phone}" required="true"/>

<lightning:input aura:id="contactField" type="email" name="email" label="Email"
    value="{!v.simpleNewContact.Email}" />

<lightning:button label="Cancel" onclick="{!c.handleCancel}"
class="slds-m-top_medium" />
<lightning:button label="Save Contact" onclick="{!c.handleSaveContact}"
variant="brand" class="slds-m-top_medium"/>

</aura:component>

```

ldsQuickContactController.js

```

({
    doInit: function(component, event, helper) {
        component.find("contactRecordCreator").getNewRecord(
            "Contact", // objectApiName
            null, // recordTypeId
            false, // skip cache?
            $A.getCallback(function() {
                var rec = component.get("v.newContact");
                var error = component.get("v.newContactError");
                if(error || (rec === null)) {
                    console.log("Error initializing record template: " + error);
                }
                else {
                    console.log("Record template initialized: " + rec.apiName);
                }
            })
        );
    },
    handleSaveContact: function(component, event, helper) {
        if(helper.validateContactForm(component)) {
            component.set("v.simpleNewContact.AccountId", component.get("v.recordId"));

            component.find("contactRecordCreator").saveRecord(function(saveResult) {
                if (saveResult.state === "SUCCESS" || saveResult.state === "DRAFT") {

                    // Success! Prepare a toast UI message
                    var resultsToast = $A.get("e.force:showToast");

```

```
        resultsToast.setParams({
            "title": "Contact Saved",
            "message": "The new contact was created."
        });

        // Update the UI: close panel, show toast, refresh account page
        $A.get("e.force:closeQuickAction").fire();
        resultsToast.fire();

        // Reload the view so components not using force:recordData
        // are updated
        $A.get("e.force:refreshView").fire();
    }
    else if (saveResult.state === "INCOMPLETE") {
        console.log("User is offline, device doesn't support drafts.");
    }
    else if (saveResult.state === "ERROR") {
        console.log('Problem saving contact, error: ' +
            JSON.stringify(saveResult.error));
    }
    else {
        console.log('Unknown problem, state: ' + saveResult.state +
            ', error: ' + JSON.stringify(saveResult.error));
    }
},
),
},
),

handleCancel: function(component, event, helper) {
    $A.get("e.force:closeQuickAction").fire();
},
})
)
```

 **Note:** The callback passed to `getNewRecord()` must be wrapped in `$A.getCallback()` to ensure correct access context when the callback is invoked. If the callback is passed in without being wrapped in `$A.getCallback()`, any attempt to access private attributes of your component results in access check failures.

Even if you're not accessing private attributes, it's a best practice to always wrap the callback function for `getNewRecord()` in `$A.getCallback()`. Never mix (contexts), never worry.

ldsQuickContactHelper.js

```
{
    validateContactForm: function(component) {
        var validContact = true;

        // Show error messages if required fields are blank
        var allValid = component.find('contactField').reduce(function (validFields,
inputCmp) {
            inputCmp.showHelpMessageIfInvalid();
            return validFields && inputCmp.get('v.validity').valid;
        }, true);

        if (allValid) {
            // Verify we have an account to attach it to
```

```

        var account = component.get("v.account");
        if($A.util.isEmpty(account)) {
            validContact = false;
            console.log("Quick action context doesn't have a valid account.");
        }
        return(validContact);
    }
}
)

```

SEE ALSO:

- [Configure Components for Record-Specific Actions](#)
- [Controlling Access](#)

SaveRecordResult

Represents the result of a Lightning Data Service operation that makes a persistent change to record data.

SaveRecordResult Object

Callback functions for the `saveRecord` and `deleteRecord` functions receive a `SaveRecordResult` object as their only argument.

| Attribute Name | Type | Description |
|----------------------------|--------|--|
| <code>objectApiName</code> | String | The object API name for the record. |
| <code>entityLabel</code> | String | The label for the name of the sObject of the record. |
| <code>error</code> | String | Error is one of the following. <ul style="list-style-type: none"> • A localized message indicating what went wrong. • An array of errors, including a localized message indicating what went wrong. It might also include further data to help handle the error, such as field- or page-level errors. <p><code>error</code> is undefined if the save <code>state</code> is SUCCESS or DRAFT.</p> |
| <code>recordId</code> | String | The 18-character ID of the record affected. |
| <code>state</code> | String | The result state of the operation. Possible values are: <ul style="list-style-type: none"> • SUCCESS—The operation completed on the server successfully. • DRAFT—The server wasn't reachable, so the operation was saved locally as a draft. The change is applied to the server when it's reachable. • INCOMPLETE—The server wasn't reachable, and the device doesn't support drafts. (Drafts are supported only in the Salesforce app.) Try this operation again later. |

| Attribute Name | Type | Description |
|----------------|------|---|
| | | <ul style="list-style-type: none">• ERROR—The operation couldn't be completed. Check the <code>error</code> attribute for more information. |

CHAPTER 12 Testing Components with Lightning Testing Service

In this chapter ...

- [How Lightning Testing Service Works](#)
- [Install Lightning Testing Service](#)
- [Get Started with Lightning Testing Service](#)
- [Explore the Example Test Suites](#)
- [Write Your Own Tests](#)
- [Use Other Frameworks](#)

Use Lightning Testing Service (LTS) to ensure your components perform as expected. LTS is a full suite of tools and services integrated with Salesforce DX to make testing easy.

Automated tests are the best way to achieve predictable, repeatable assessments of the quality of your custom code. Writing automated tests for your custom components gives you confidence that they work as designed, and allows you to evaluate the impact of changes, such as refactoring, or of new versions of Salesforce or third-party JavaScript libraries.

LTS supports testing with standard JavaScript test frameworks. It provides easy-to-use wrappers for using [Jasmine](#) and [Mocha](#). If you prefer to use an alternative test framework, you can wrap it yourself.

How Lightning Testing Service Works

LTS simplifies building test suites, and is fully integrated with Salesforce DX.

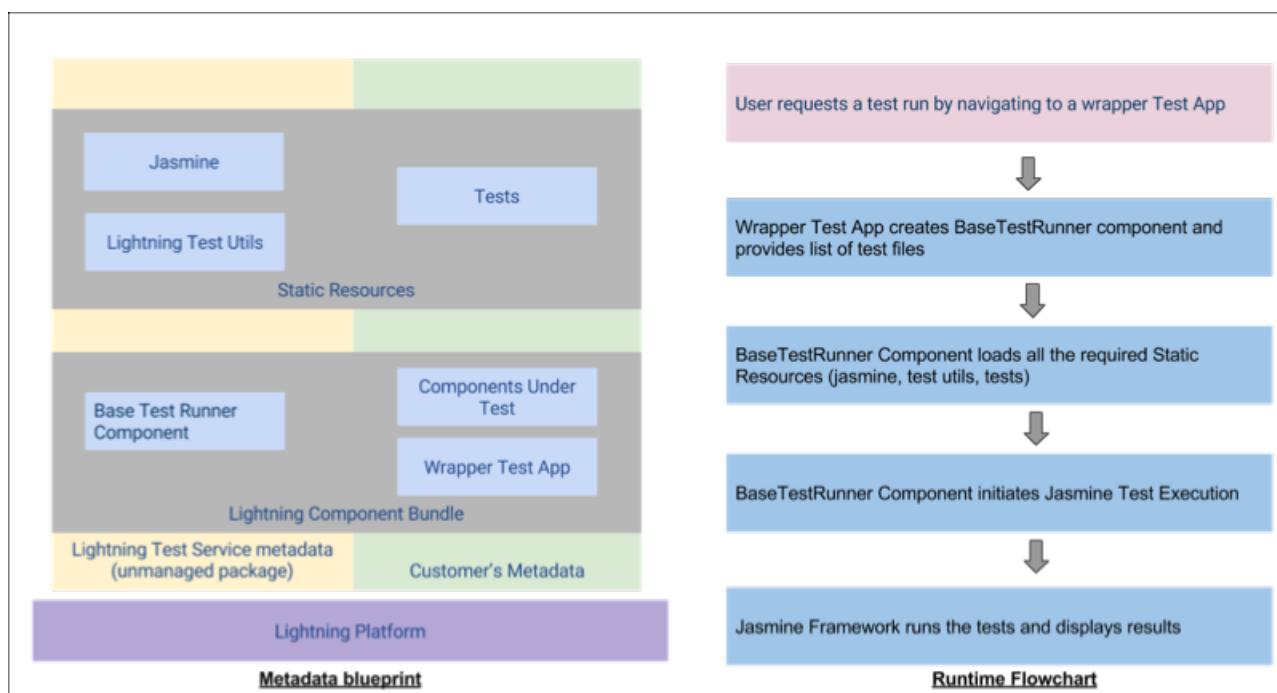
LTS consists of two major components:

- The LTS unmanaged package, listed by release version on the project [Releases](#) page
- The LTS `install` command for the Salesforce CLI

The unmanaged package includes LTS infrastructure, including a test runner app, and some example tests. Once the package is installed in your org, you can run the example tests by going to the following URL:

```
yourInstance/c/jasmineTests.app
```

When you run tests manually in a browser, you're using only the pieces of LTS provided in the package.



For more sophisticated development processes, use the LTS commands included with the [Salesforce DX](#) CLI plugin. The Salesforce CLI allows you to integrate LTS into your automated testing, continuous integration, and other source-based development processes.

The command line tool automates running your test suites. It opens the same URL you can open manually, and uses WebDriver to observe the test suite as it runs. Then it parses and packages the results for use in command line-based development processes.

Installing LTS is a one line command in the Salesforce DX CLI. Once installed, you can work with your test suite in various ways from the command line.



Note: If you just want to “kick the tires,” that’s cool, too. You can manually install the LTS unmanaged package. The package provides the test service app and an example test suite. It also includes example components that the test suite runs against. You run the test suite by accessing the URL for the LTS app in your org.

Write your tests using a JavaScript testing framework of your choosing. We provide easy-to-use wrappers for [Jasmine](#) and [Mocha](#).

A simple Jasmine test spec looks like the following:

```
/**  
 * This is a 'hello world' Jasmine test spec  
 */  
describe("A simple passing test", function() {  
    it("checks that true is always true", function() {  
        expect(true).toBe(true);  
    });  
});
```

A Mocha test looks similar.

```
/**  
 * This is a 'hello world' Mocha test  
 */  
var assert = require('assert');  
describe('A simple passing test', function() {  
    it('checks that true is always true', function() {  
        assert.equal(true, true);  
    });  
});
```

You can write your own wrapper if you prefer a different testing framework. It's not hard, but plan on half a day to a day of work.

LTS also provides utilities specific to the Lightning Component framework, which let you test behavior specific to Lightning components. Details are explained in comments in the example tests.

Your test suite is deployed in the form of an archive (zip) static resource. Once LTS is installed and configured, you make changes to your test suite, create the archive, and upload it to your org. Once uploaded you can run the test suite via the command line or via URL.

 **Warning:** Don't run tests in your production org. LTS doesn't provide an isolated test context or transaction wrapper. **DML operations you perform in your tests won't be rolled back at the end of the test.** We recommend that you run your LTS test suites *only* in scratch orgs, using data provided by the test suite itself.

Install Lightning Testing Service

You have two ways to install LTS. The simplest way is to use the Salesforce DX CLI. If you're not using Salesforce DX, you can manually install the unmanaged package.

Use Salesforce DX to Install Lightning Testing Service

Salesforce DX includes a one line command for automatically installing the LTS unmanaged package. The Salesforce DX CLI also allows you to use the `sfdx` command line tool to perform automated testing as part of your development process, including automated process, such as continuous integration.

1. If you haven't already, [enable Dev Hub in your org](#).
2. [Install the Salesforce CLI](#) and verify your installation.
3. Verify that the Salesforce DX CLI plug-in is updated.

```
sfdx update
```

- Log in to your Dev Hub org.

```
sfdx force:auth:web:login -d
```

- (Optional but highly recommended) Clone the [LightningTestingService Github repo](#), which contains the sample configuration file and more.

- Create a scratch org. The following command uses the sample configuration file from the LightningTestingService repo.

```
cd path/to/LightningTestingService
sfdx force:org:create -s -f config/project-scratch-def.json -a scratch1
```

To customize your scratch org settings with a company name, email address, and so on, edit the configuration file: /LightningTestingService/config/project-scratch-def.json.

It's best to perform automated testing in a clean org, created with consistent settings.

- Install the LTS package.

```
sfdx force:lightning:test:install
```

This command installs the latest version of the LTS package into your default SFDX org. See the help for the `install` command for more options.

After you install Salesforce CLI and LTS, you can run your tests from the command line.

```
sfdx force:lightning:test:run -a jasmineTests.app
```

When you run your tests, you see output in your CLI that tells you that the command line tools are working and connected to your development org.

```
The Lightning Data Service Examples : c:egLdsView : updates the component with a
message when a record is deleted
      Pass                                2323

==== Test Summary
NAME          VALUE
-----
Outcome       Passed
Tests Ran     18
Passing       17
Failing        0
Skipped        1
Pass Rate     100%
Fail Rate     0%
Test Start Time Mar 21, 2018 10:18 PM
Test Execution Time 7935 ms
Test Total Time 7935 ms
Command Time   17689 ms
Hostname       https://[REDACTED].my.salesforce.com
Org Id         [REDACTED]
Username       test-[REDACTED]@example.com

Test run complete
```

See the command line help for other useful details.

```
sfdx force:lightning:test:run --help
```

Install Lightning Testing Service as an Unmanaged Package

If you're not using Salesforce DX, you're missing a lot, but you can still use LTS. Installing the LTS package is just like [installing any other unmanaged package](#).

1. Log in to your org. We recommend that you use a new DE org for evaluating LTS.
2. Go to the project [Releases](#) page, and click the package installation URL for the latest release.
3. Authenticate again with the credentials for your DE org.
4. Follow the normal package installation prompts. We recommend installing the package for admins only.

LTS Package Contents

However you install it, the LTS package includes the following items:

1. Example test suites
 - Jasmine JavaScript files in archive static resources
 - Mocha JavaScript files in archive static resources
2. Example components to be tested
 - Components, an Apex class, and a custom label
3. LTS infrastructure
 - Jasmine framework and wrapper
 - Mocha framework and wrapper
 - LTS test utilities
 - Test runner component
 - Wrapper test app

Get Started with Lightning Testing Service

Let's see LTS in action.

These steps assume you've already followed the [Install Lightning Testing Service](#) instructions.

1. From your project directory, create another scratch org using the configuration file from the cloned LightningTestingService repo.

```
sfdx force:org:create -s -f config/project-scratch-def.json -a scratch1
```

2. Push metadata to the scratch org.

```
sfdx force:source:push
```

3. Run tests.

```
sfdx force:org:open -p /c/jasmineTests.app
```

You see a screen that looks something like the following.

Jasmine 2.6.1

Options

18 specs, 0 failures, 2 pending specs finished in 4.908s

A simple passing test
verifies that true is always true

A simple failing test
fails when false does not equal true PENDING WITH MESSAGE: Temporarily disabled withxit

Lightning Component Testing Examples

- c:egRenderElement
renders specific static text
- c:egComponentMethod
updates an attribute value when a method is invoked on the component's interface
- c:egClientSideAction
adds items to a list when the client-side action is invoked
- c:egServerSideActionCallback
[Discouraged: brittle, slow, side-effects] receives server data when server-side action is invoked PENDING WITH MESSAGE: Temporarily disabled withxit
- c:egServerSideActionCallback
updates with provided data when action callback is invoked directly
- c:egServerSideActionCallback
updates with provided data when invoked via a mocked server action using Jasmine spies
- c:egAttributeTypes
sets component attributes of various types and values
- c:egFacet
renders the expected content when used as a facet
- c:egGlobalValueProvider
renders a custom label
- c:egConditionalUI
renders only the "truthy" (conditional) portion of the user interface
- c:egEventHandling
handles component- and application-level events

The Lightning Data Service example component (c:egLdsView)
updates the component and loads record data when a record is created
loads a record and logs a success message when a record is reloaded
updates data held in the client-side component when a record is saved
updates the component with a message when a record is deleted
handles errors with a message when there's an error with data access

How to Push Data to a Developer Edition Org

Salesforce DX is designed to work with a Dev Hub and scratch orgs. If you have a normal DE org you'd like to work with, the commands are slightly different.

```
sfdx force:auth:web:login -s      # connect to your DE org  
sfdx force:mdapi:convert        # convert metadata for Salesforce DX projects  
sfdx force:mdapi:deploy         # deploy local source to the DE org
```

Explore the Example Test Suites

To learn how to write tests for your Aura components, dive into the test suites and explore the tests and components side-by-side.

Open the test suite file in one window, and in another window (perhaps in your IDE) open the simple components being tested.

The components and the test suites included in the unmanaged package are also available in a repository on GitHub.

<https://github.com/forcedotcom/LightningTestingService>

Components for Testing

All of the testable components have names beginning with “eg” (from the abbreviation “e.g.”, meaning for example). They contain extensive comments to guide you through each one. Access the components provided in the package as you would access any Aura component.

- In the Developer Console
- In the Force.com IDE, in the `/aura/` directory
- By converting your org’s metadata into a format that you can work with locally, using Salesforce DX
- Directly from the LightningTestingService repo in the [lightning-component-tests/main/default/aura](#) directory.

We include more than a dozen components, designed to be used in illustrative tests. Each of the components has a description of its behavior in its `.auradoc` documentation file.

Test Suites

The example tests are included in static resources. You can also review them directly in the LightningTestingService repo, in the [lightning-component-tests/test/default/staticresources](#) directory.

The LTS package includes four test suites, three for Jasmine and one for Mocha:

- `jasmineHelloWorldTests.resource`—A very simple Jasmine example including one passing and one failing test.
- `jasmineExampleTests.resource`—The main Jasmine example test suite.
- `jasmineLightningDataServiceTests.resource`—Some Jasmine examples specific to testing Lightning Data Service-based components.
- `mochaExampleTests.resource`—The Mocha example test suite, which provides examples parallel to the main Jasmine test suite.

The `jasmineExampleTests.resource` and `mochaExampleTests.resource` files are each a single JavaScript file containing a complete test suite. These are single files for convenience in delivery and exploration. Your own test suites can include many such files. The test suites are copiously commented to help you learn.

This directory also exposes the [\\$T utility object](#). This object has methods that simplify routine testing operations. Notice that these methods are used throughout the example test scripts in the repo.

The remaining static resources are infrastructure used by LTS. They’re *briefly* described in [Use Other Frameworks](#).

Write Your Own Tests

Lightning Testing Service guides you through broad testing coverage of a component’s expected behavior using the Jasmine or Mocha test frameworks.

While working with Aura components, consider writing tests for the following.

DOM rendering

Validate that components are added where and when they should be.

Component state

Ensure that components respond as expected.

Server-side callback response

Get the right response from a call to another service or resource.

Validation of variables

Do you have variable values that load from other sources, especially remote ones? Make sure that they do.

Conditional UI rendering

Verify what users see when you want them to see it.

Event Handling

Test responses to events.

Fortunately, the LightningTestingService Github repo contains examples of all of these cases in the [staticresources directory](#) for both Jasmine and Mocha testing frameworks.

Jasmine is well documented here: <https://jasmine.github.io> and provides a simple setup.

Mocha is well documented here: <https://mochajs.org>. Mocha is newer and might require some plugins to get the results you want. Both test frameworks use a `describe...it` block structure.

Use an `it` function to define what you're testing, and what you expect (or explicitly don't expect) to happen. To provide a name for the test, wrap each function in a `describe` block. Group `it` functions together within the block. Grouped functions can share variables and other values within the block.

```
describe("A suite that passes", function() {
  it("spec that verifies that true is true", function() {
    expect(true).toBe(true);
  });
  it("spec that verifies that false is false", function() {
    expect(false).toBe(false);
  });
});
```

You could rearrange the test to have both `it` functions within the one `describe` function, or also test for the negative case:
`expect(true).not.toBe(false);`

You have several options to get similar results. The key is to focus on the outcome of the `it` function.

For example, the `jasmineHelloWorldTests.resource` contains a unit test that validates a state change.

```
describe('c:egComponentMethod', function() {
  it("updates an attribute value when a method is invoked on the component's interface", function(done) {
    $T.createComponent("c:egComponentMethod", null)
      .then(function(component) {
        component.sampleMethod();
        expect(component.get("v.status")).toBe("sampleMethod invoked");
        done();
      })
      .catch(function(e) {
        done.fail(e);
      });
  });
});
```

When you've written your test suite, use the CLI to push and run the tests.

Use the \$T Utility Object

LTS includes the [\\$T utility object](#). This object has methods that simplify routine testing operations. In the example above, the `$T.createComponent()` method creates the component with the descriptor `c:egComponentMethod` with no specific attributes. However, you can use the `$T.createComponent()` method to add attributes or insert the component into the DOM.

Learn more

The [LightningTestingService Github repo](#) has ongoing solutions and discussions of known issues.

Use Other Frameworks

Create Aura component wrappers to use testing frameworks other than Jasmine or Mocha.

LTS provides a way to use standard JavaScript test frameworks with your Lightning components. We've provided the example test suites implemented in [Jasmine](#) and [Mocha](#). These are well-regarded test frameworks, and if you haven't chosen one already, we recommend you start with one of them.

If you'd prefer to use another test framework, either because you've already selected one, or because you find something more to your taste, you can use it with LTS instead.

All of the packaged pieces of LTS are included in the project repository, in the [lightning-component-tests/test/default](#) directory. To create a wrapper for another test framework, modify or replace these items from the Jasmine wrapper.

- `aura/jasmineTests`—The front end of LTS is simple app includes the test runner component, and a list of test suites to feed it.
- `aura/lts_jasmineRunner`—the test runner component for Jasmine. It includes references to the required Jasmine library, which it loads along with the test spec resources, and then fires the test runner.
- `lts_jasmine.resource`—the Jasmine library, unmodified.
- `lts_jasmineboot.resource`—JavaScript IIFE that launches Jasmine in the LTS context.
- `lts_testutil.resource`—A collection of utilities for use within your test specs, and by the test framework wrappers. They provide Lightning component-specific functions that make it easier to test your custom components from a test context.

The Mocha version of the framework wrapper provides similar files. You might find the similarities and differences instructive in creating your own adapter for other frameworks.

CHAPTER 13 Debugging

In this chapter ...

- [Enable Debug Mode for Lightning Components](#)
- [Disable Caching Setting During Development](#)
- [Salesforce Lightning Inspector Chrome Extension](#)
- [Log Messages](#)

There are a few basic tools and techniques that can help you to debug applications.

Use Chrome DevTools to debug your client-side code.

- To open DevTools on Windows and Linux, press Control-Shift-I in your Google Chrome browser. On Mac, press Option-Command-I.
- To quickly find which line of code is failing, enable the **Pause on all exceptions** option before running your code.

To learn more about debugging JavaScript on Google Chrome, refer to the [Google Chrome's DevTools](#) website.

Enable Debug Mode for Lightning Components

Enable debug mode to make it easier to debug JavaScript code from Lightning components. Only enable debug mode for users who are actively debugging JavaScript. Salesforce is slower for users who have debug mode enabled.

The Lightning Component framework executes in one of two modes: production and debug.

Production Mode

By default, the framework runs in production mode. This mode is optimized for performance. Framework code is optimized and “minified” to reduce the size of the JavaScript code. As a result of this process, the JavaScript code served to the browser is obfuscated.

Optimization and minification are performed on framework code only. Custom component code is **not** minified or obfuscated. Untouched custom component code includes both components you create yourself, and components installed as part of a managed package.

! **Important:** Minification is a performance optimization, not intellectual property protection. Code that's minified is hard to read, but it's not encrypted or otherwise prevented from being viewed.

Debug Mode

When you enable debug mode, framework JavaScript code isn't minified and is easier to read and debug. Debug mode also adds more detailed output for some warnings and errors. As with production mode, custom component code is not optimized or minified.

! **Important:** Debug mode has a significant performance impact. Salesforce is slower for any user who has debug mode enabled. For this reason, we recommend using it only when actively debugging JavaScript code, and only for users involved in debugging activity. Don't leave debug mode on permanently. Users who have debug mode enabled see a banner notification once a week while it's enabled.

To enable debug mode for users in your org:

1. From Setup, enter *Debug Mode* in the Quick Find box, then select **Debug Mode Users**.
Users with debug mode enabled have a check mark in the Debug Mode column.
2. In the user list, locate any users who need debug mode enabled. If necessary, use the standard list view controls to filter your org's users.
3. Enable the selection checkbox next to users for whom you want to enable debug mode.
4. Click **Enable**.

To disable debug mode for a user, follow the preceding steps and click **Disable** instead of **Enable**.

Disable Caching Setting During Development

Disable the secure and persistent browser caching setting during development in a sandbox or Developer Edition org to see the effect of any code changes without needing to empty the cache.

The caching setting improves page reload performance by avoiding extra round trips to the server.

! **Warning:** Disabling secure and persistent browser caching has a significant negative performance impact on Lightning Experience. Always enable the setting in production orgs.

1. From Setup, enter *Session* in the Quick Find box, and then select **Session Settings**.

Editions

Available in: Salesforce Classic ([not available in all orgs](#)) and Lightning Experience

Available for use in: **Contact Manager, Group, Professional, Enterprise, Performance, Unlimited, and Developer** Editions

Create Lightning components using the UI in **Enterprise, Performance, Unlimited, Developer** Editions, or a sandbox.

2. Deselect the checkbox for “Enable secure and persistent browser caching to improve performance”.
3. Click **Save**.

SEE ALSO:

[Enable Secure Browser Caching](#)

Salesforce Lightning Inspector Chrome Extension

The Salesforce Lightning Inspector is a Google Chrome DevTools extension that enables you to navigate the component tree, inspect component attributes, and profile component performance. The extension also helps you to understand the sequence of event firing and handling.

The extension helps you to:

- Navigate the component tree in your app, inspect components and their associated DOM elements.
- Identify performance bottlenecks by looking at a graph of component creation time.
- Debug server interactions faster by monitoring and modifying responses.
- Test the fault tolerance of your app by simulating error conditions or dropped action responses.
- Track the sequence of event firing and handling for one or more actions.

This documentation assumes that you are familiar with [Google Chrome DevTools](#).

IN THIS SECTION:

[Install Salesforce Lightning Inspector](#)

Install the Google Chrome DevTools extension to help you debug and profile component performance.

[Salesforce Lightning Inspector](#)

The Chrome extension adds a Lightning tab to the DevTools menu. Use it to inspect different aspects of your app.

Install Salesforce Lightning Inspector

Install the Google Chrome DevTools extension to help you debug and profile component performance.

1. In Google Chrome, navigate to the [Salesforce Lightning Inspector](#) extension page on the Chrome Web Store.
2. Click the **Add to Chrome** button.

Salesforce Lightning Inspector

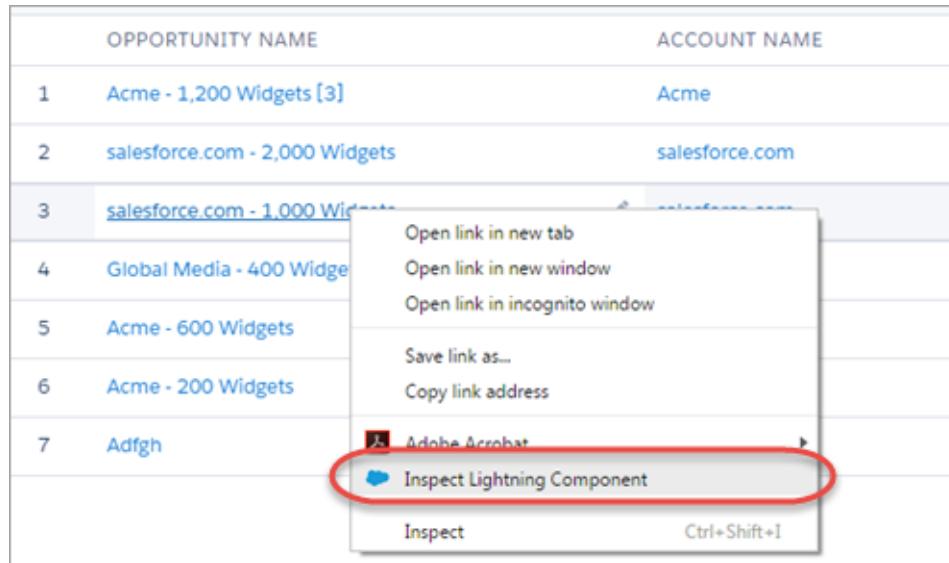
The Chrome extension adds a Lightning tab to the DevTools menu. Use it to inspect different aspects of your app.

1. Navigate to a page containing an Aura component, such as Lightning Experience (`one . app`).
2. Open the Chrome DevTools (**More tools > Developer tools** in the Chrome control menu).

You should see a Lightning tab in the DevTools menu.



To get information quickly about an element on a Lightning page, right-click the element and select **Inspect Lightning Component**.



You can also click an Aura component in the DevTools Elements tab or an element with a `data-aura-rendered-by` attribute to see a description and attributes.

The screenshot shows the DevTools Elements tab with the Lightning subtab selected. The left pane shows component markup, and the right pane shows component attributes. The 'Attributes' section is circled in red.

```

<aura:html globalId="1:11;a" tag="div" HTMLAttributes="{}">
  <ui:containerManager globalId="1298:11;a" registeredContainers="[]"/>
  <one:panelManager globalId="1301:11;a" registeredPanels="[]"/>
  <useSharedContainer>true</useSharedContainer>
  <instrumentation:uiManager globalId="1305:11;a">
    <force:modalSpinner globalId="1308:11;a">
      <force:hoverPrototypeManager globalId="1331:11;a">
        <force:content:filemanager globalId="1339:11;a" isPreviewEnabled="true" previewActionsContext="LIST__VIEW__RECORD" previewHandleShowToasts="true">
          tag: div
          HTMLAttributes: {...}
          &gt; class: function(){}
        </force:content:filemanager>
      </force:hoverPrototypeManager>
    </force:modalSpinner>
  </instrumentation:uiManager>
</aura:html>

```

Use the following subtabs to inspect different aspects of your app.

IN THIS SECTION:

Component Tree Tab

This tab shows the component markup including the tree of nested components.

Performance Tab

The Performance tab shows a flame graph of the creation time for your components. Look at longer and deeper portions of the graph for potential performance bottlenecks.

Transactions Tab

Some apps delivered by Salesforce include transaction markers that enable you to see fine-grained metrics for actions within those transactions. You can't create your own transactions.

[Event Log Tab](#)

This tab shows all the events fired. The event graph helps you to understand the sequence of events and handlers for one or more actions.

[Actions Tab](#)

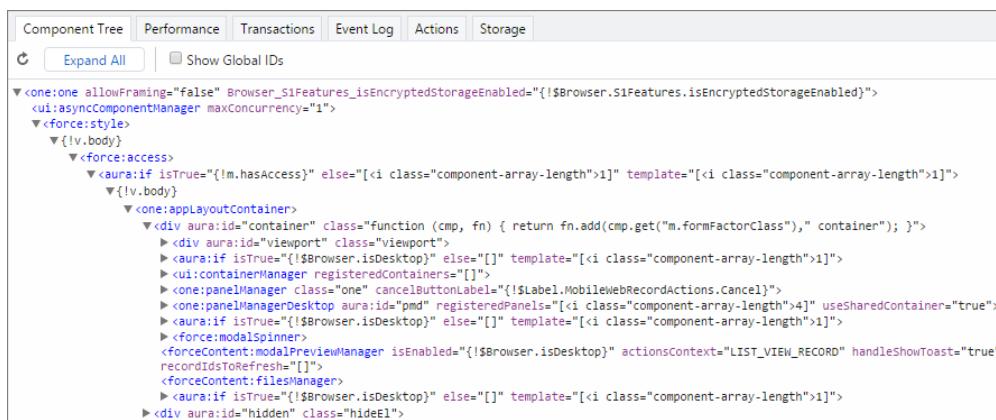
This tab shows the server-side actions executed. The list automatically refreshes when the page updates.

[Storage Tab](#)

This tab shows the client-side storage for Lightning applications. Actions marked as storables are stored in the `actions` store. Use this tab to analyze storage in the Salesforce mobile app and Lightning Experience.

Component Tree Tab

This tab shows the component markup including the tree of nested components.



The screenshot shows the Component Tree tab interface. At the top, there are tabs for Component Tree, Performance, Transactions, Event Log, Actions, and Storage. Below the tabs are two buttons: 'Expand All' and 'Show Global IDs'. The main area displays a hierarchical tree of component markup. The root node is a `<one:one` component with the attribute `allowFraming="false"`. It has several child nodes, including `<aura:if`, `<kul:asyncComponentManager`, and `<force:style`. One of the `<aura:if` nodes has a condition `isTrue="={!m.hasAccess}"`. The tree continues with nested `<div`, `<force:access`, and `<force:modalSpinner` components, illustrating the complex structure of the component tree.

Collapse or Expand Markup

Expand or collapse the component hierarchy by clicking a triangle at the start of a line.

Refresh the Data

The component tree is expensive to serialize, and doesn't respond to component updates. You must manually update the tree when necessary by scrolling to the top of the panel and clicking the Refresh  icon.

See More Details for a Component

Click a node to see a sidebar with more details for that selected component. While you must manually refresh the component tree, the component details in the sidebar are automatically refreshed.

The screenshot shows the 'Component Tree' tab of the Salesforce Lightning Inspector. On the left, a tree view displays component definitions with expand/collapse arrows. On the right, detailed information for a selected component is shown, including its descriptor, global ID, is rendered status, invalid status, HTML elements count, rerendered count, attribute & facet value provider, body, registered containers, and super components.

The sidebar contains these sections:

Top Panel

- **Descriptor**—Description of a component in a format of `prefix://namespace:name`
- **Global ID**—The unique identifier for the component for the lifetime of the application
- **aura:id**—The local ID for the component, if it's defined
- **IsRendered**—A component can be present in the component tree but not rendered in the app. The component is rendered when it's included in `v.body` or in an expression, such as `{ !v.myCmp }`.
- **IsValid**—When a component is destroyed, it becomes invalid. While you can still hold a reference to an invalid component, it should not be used.
- **HTML Elements**—The count of HTML elements for the component (including children components)
- **Rerendered**—The number of times the component has been rerendered since you opened the Inspector. Changing properties on a component makes it dirty, which triggers a rerender. Rerendering can be an expensive operation, and you generally want to avoid it, if possible.
- **Attribute & Facet Value Provider**—The attribute value provider and facet value provider are usually the same component. If so, they are consolidated into one entry.

The attribute value provider is the component that provides attribute values for expressions. In the following example, the name attribute of `<c:myComponent>` gets its value from the `avpName` attribute of its attribute value provider.

```
<c:myComponent name="{ !v.avpName }" />
```

The facet value provider is the value provider for facet attributes (attributes of type `Aura.Component[]`). The facet value provider can be different than the attribute value provider for the component. We won't get into that here as it's complicated! However, it's important to know that if you have expressions in facets, the expressions use the facet value provider instead of the attribute value provider.

Attributes

Shows the attribute values for a component. Use `v.attributeName` when you reference an attribute in an expression or code.

[[Super]]

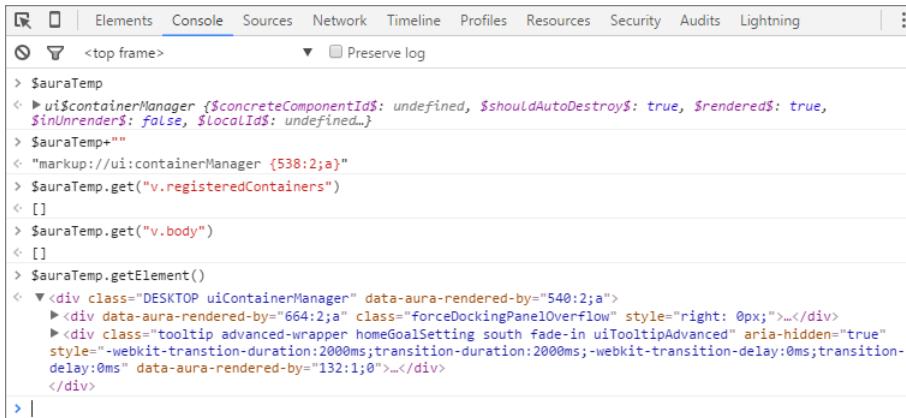
When a component extends another component, the sub component creates an instance of the super component during its creation. Each of these super components has their own set of properties. While a super component has its own attributes section, the super component only has a `body` attribute. All other attribute values are shared in the extension hierarchy.

Model

Some components you see might have a Model section. Models are a deprecated feature and they are included simply for debugging purposes. Don't reference models or your code will break.

Get a Reference to a Component in the Console

Click a component reference anywhere in the Inspector to generate a `$auraTemp` variable that points at that component. You can explore the component further by referring to `$auraTemp` in the Console tab.



```

Elements Console Sources Network Timeline Profiles Resources Security Audits Lightning
<top frame> Preserve log
> $auraTemp
< > ui$containerManager {$_concreteComponentId$: undefined, $shouldAutoDestroy$: true, $rendered$: true,
$shouldInRender$: false, $localId$: undefined,...}
> $auraTemp+"
< "markup://ui:containerManager {538:2;a}"
> $auraTemp.get("v.registeredContainers")
< []
> $auraTemp.get("v.body")
< []
> $auraTemp.getElement()
< <div class="DESKTOP_uicontainerManager" data-aura-rendered-by="540:2;a">
  > <div data-aura-rendered-by="664:2;a" class="forceDockingPanelOverflow" style="right: 0px;"></div>
  > <div class="tooltip advanced-wrapper homeGoalSetting south fade-in uiTooltipAdvanced" aria-hidden="true"
    style="-webkit-transition-duration:2000ms;transition-duration:2000ms;-webkit-transition-delay:0ms;transition-
    delay:0ms" data-aura-rendered-by="132:1;0"></div>
</div>
> |

```

These commands are useful to explore the component contents using the `$auraTemp` variable.

`$auraTemp+"`

Returns the component descriptor.

`$auraTemp.get("v.attributeName")`

Returns the value for the `attributeName` attribute.

`$auraTemp.getElement()`

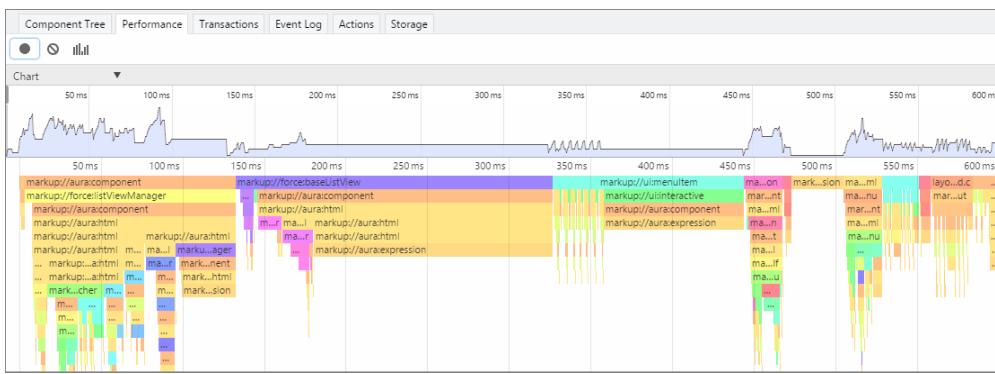
Returns the corresponding DOM element.

`inspect($auraTemp.getElement())`

Opens the Elements tab and inspects the DOM element for the component.

Performance Tab

The Performance tab shows a flame graph of the creation time for your components. Look at longer and deeper portions of the graph for potential performance bottlenecks.



Record Performance Data

Use the Record , Clear , and Show current collected  buttons to gather performance data about specific user actions or collections of user actions.

- To start gathering performance data, press .

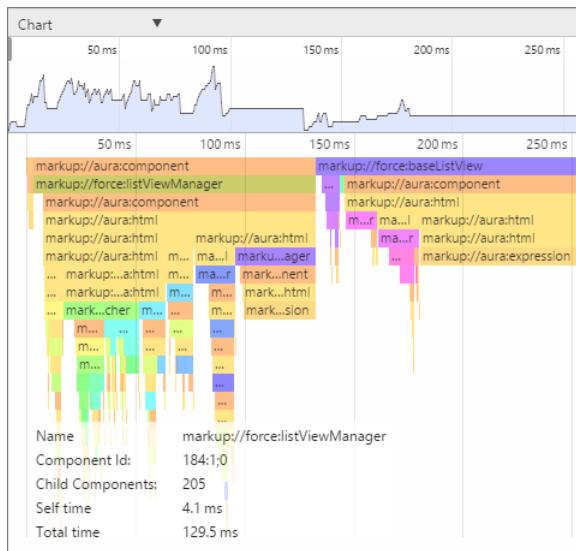
2. Take one or more actions in the app.
3. To stop gathering performance data, press .

The flame graph for your actions displays. To see the graph before you stop recording, press the  button.

See More Performance Details for a Component

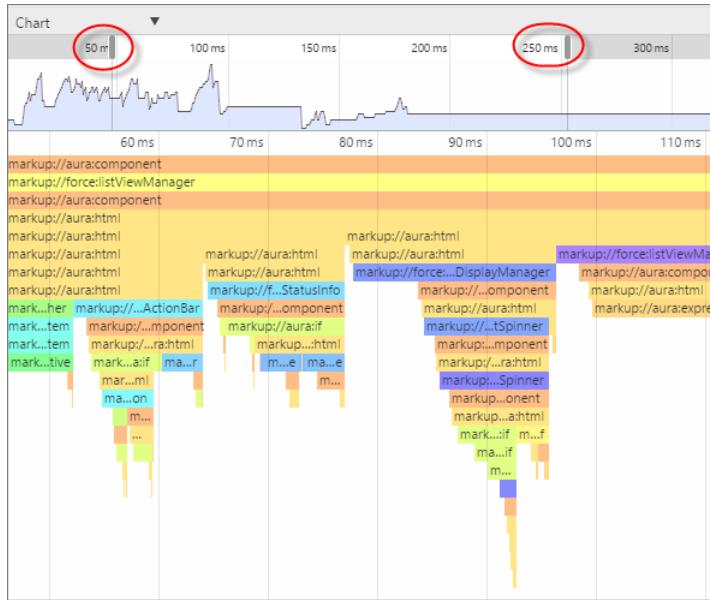
Hover over a component in the flame graph to see more detailed information about that component in the bottom-left corner. The component complexity and timing information can help diagnose performance issues.

| This measure... | Is the time it took to complete... |
|-----------------------|---|
| Self time | The current function. It excludes the completion time for functions it invoked. |
| Aggregated self time | All invocations of the function across the recorded timeline. It excludes the completion time for functions it invoked. |
| Total time | The current function and all functions that it invoked. |
| Aggregated total time | All invocations of the function across the recorded timeline, including completion time for functions it invoked. |



Narrow the Timeline

Drag the vertical handles on the timeline to select a time window to focus on. Zoom in on a smaller time window to inspect component creation time for potential performance hot spots.



Transactions Tab

Some apps delivered by Salesforce include transaction markers that enable you to see fine-grained metrics for actions within those transactions. You can't create your own transactions.

| Component Tree | Performance | Transactions | Event Log | Actions | Storage |
|---|-------------|--------------|-----------|---------|------------------|
| | | | | | |
| ltnng:bootstrap | 4970ms | 0ms | 1128ms | 3579ms | 6029ms |
| ltnng:bootstrap | 2580ms | 0ms | | | [0ms - 4970ms] |
| aura:error:storage | 0ms | 1128.41ms | | | |
| aura:error:storage | 0ms | 1175.74ms | | | |
| one:trialExperience | 1186ms | 3504.26ms | | | |
| ltnng:performance | 2623ms | 3806.79ms | | | |
| ltnng:performance | 2625ms | 3812.75ms | | | |
| ltnng:performance | 2626ms | 3813.1ms | | | |
| ltnng:Routing1:ResolveRouteForComponent | 9ms | 5190.05ms | | | |
| S1PERF:entityNavigation | 43ms | 5205.81ms | | | |
| FLEXIPERF:GetPageFromServer | 632ms | 5238.24ms | | | |
| http-request {0} | 0 | 230ms | 5407ms | | |
| serviceComponent://ui_global.components.one.system | 106;a | 240ms | 5400ms | | |
| Message.SystemMessageController/ACTION\$getSystemMessages | | | | | |

| Measure | Description |
|------------|---|
| Duration | The page duration since the page start time, in milliseconds |
| Start Time | The start time when the page was last loaded or refreshed, in milliseconds |
| Timeline | <p>The start and end times of a transaction, represented by a colored bar:</p> <ul style="list-style-type: none"> Green — How long the action took on the server Yellow — XMLHttpRequest transaction Blue — Queued time until the XMLHttpRequest transaction was sent Purple — Custom transaction |

Event Log Tab

This tab shows all the events fired. The event graph helps you to understand the sequence of events and handlers for one or more actions.

| Component Tree | Performance | Transactions | Event Log | Actions | Storage |
|------------------------|-------------|--------------|-----------|---------|---------|
| ▶ ui:scrollerRefreshed | CMP | | | | |
| ▶ ui:carouselPageEvent | CMP | | | | |
| ▶ ui:notify | CMP | | | | |
| ▶ aura:methodCall | CMP | | | | |
| ▶ aura:methodCall | CMP | | | | |
| ▶ ui:notify | CMP | | | | |

Record Events

Use the Toggle recording  and Clear  buttons to capture specific user actions or collections of user actions.

1. To start gathering event data, press .
2. Take one or more actions in the app.
3. To stop gathering event data, press .

View Event Details

Expand an event to see more details. In the call stack, click an event handler (for example, `c.handleDataChange`) to see where it's defined in code. The handler in the yellow row is the most current.

| ◀ ui:dataChanged | CMP | | | | | |
|--|--|--|-------------|------------|--|---|
| Parameters | +{...} | | | | | |
| Caller | <pre>function(dataProvider, data, currentPage) { var dataChangeEvent = dataProvider.getEvent("onchange"); dataChangeEvent .setComponentEvent() .setParams({ data: data, currentPage: currentPage }).fire(); }</pre> | | | | | |
| Source | <force:listViewPickerDataProvider globalId="546:0" columns="[]" items="[]" currentPage="1" endIndex="-1" pageCount="0" pageSize="50" startIndex="-1" totalItems="0" canLoadMore="false" updatedInfiniteLoadingIdleLabel="" scope="Opportunity" listIdOrApiName="Recent" listViewTitle="Recently Viewed"> | | | | | |
| Duration | 72.7350ms | | | | | |
| Call Stack | <table border="1"> <thead> <tr> <th>Event Fired</th> <th>Handled By</th> </tr> </thead> <tbody> <tr> <td>markup://ui:dataChanged<force:listViewPickerDataProvider globalId="546:0"></td> <td> <code>c.handleDataChange</code> <code><force:virtual1AutocompleteMenuList globalId="12:1678;a"></code> <code>c.handleDataChange</code> <code><force:virtual1AutocompleteMenu globalId="1:1678;a"></code> </td></tr> </tbody> </table> | | Event Fired | Handled By | markup://ui:dataChanged<force:listViewPickerDataProvider globalId="546:0"> | <code>c.handleDataChange</code> <code><force:virtual1AutocompleteMenuList globalId="12:1678;a"></code> <code>c.handleDataChange</code> <code><force:virtual1AutocompleteMenu globalId="1:1678;a"></code> |
| Event Fired | Handled By | | | | | |
| markup://ui:dataChanged<force:listViewPickerDataProvider globalId="546:0"> | <code>c.handleDataChange</code> <code><force:virtual1AutocompleteMenuList globalId="12:1678;a"></code> <code>c.handleDataChange</code> <code><force:virtual1AutocompleteMenu globalId="1:1678;a"></code> | | | | | |

Filter the List of Events

By default, both application and component events are shown. You can hide or show both types of events by toggling the **App Events** and **Cmp Events** buttons.

Enter a search string in the `Filter` field to match any substring.

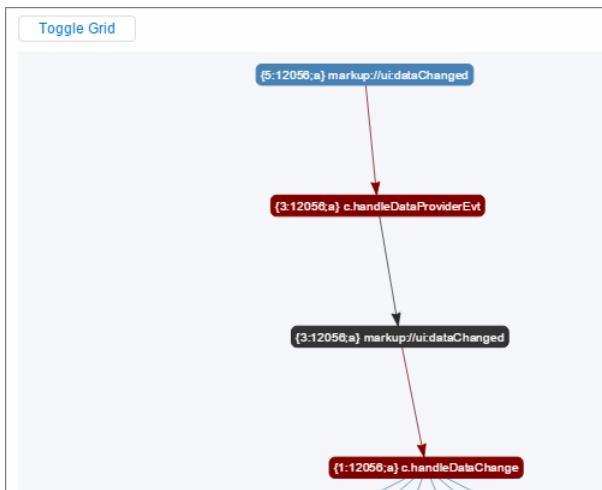
Invert the filter by starting the search string with `!`. For example, `!aura` returns all events that don't contain the string `aura`.

Show Unhandled Events

Show events that are fired but are not handled. Unhandled events aren't listed by default but can be useful to see during development.

View Graph of Events

Expand an event to see more details. Click the **Toggle Grid** button to generate a network graph showing the events fired before and after this event, and the components handling those events. Event-driven programming can be confusing when a cacophony of events explode. The event graph helps you to join the dots and understand the sequence of events and handlers.



The graph is color coded.

- **Black**—The current event
- **Maroon**—A controller action
- **Blue**—Another event fired before or after the current event

SEE ALSO:

[Communicating with Events](#)

Actions Tab

This tab shows the server-side actions executed. The list automatically refreshes when the page updates.

The screenshot shows the Actions tab in the Salesforce Lightning Inspector. At the top, there are tabs for Component Tree, Performance, Transactions, Event Log, Actions (which is selected), and Storage. Below the tabs are several filter buttons: Storable (highlighted in red), Cached, Background, Success, Incomplete, Error, and Aborted. A search bar labeled "Filter" is also present. The main area is divided into sections: PENDING, RUNNING, and COMPLETED. The PENDING section contains a single entry:

| Parameters +{...} | | | | | | |
|--------------------|-------|-----------|--------------------|----------|--------------------|------------------|
| Result undefined | | | | | | |
| Id | State | Abortable | Background | Storable | Storable Size Est. | Storable Refresh |
| 3899;a | NEW | true | false | true | 0.0 KB | false |
| Storable Cache Hit | | | Created Components | | Storage Key | +{...} |
| false | | | | | | |

The RUNNING and COMPLETED sections are currently empty.

Filter the List of Actions

To filter the list of actions, toggle the buttons related to the different action types or states.

- **Storable**—Storable actions whose responses can be cached.
- **Cached**—Storable actions whose responses are cached. Toggle this button off to show cache misses and non-storable actions. This information can be valuable if you're investigating performance bottlenecks.
- **Background**—Not supported for Aura components. Available in the open-source Aura framework.
- **Success**—Actions that were executed successfully.
- **Incomplete**—Actions with no server response. The server might be down or the client might be offline.
- **Error**—Actions that returned a server error.
- **Aborted**—Actions that were aborted.

Enter a search string in the `Filter` field to match any substring.

Invert the filter by starting the search string with `!`. For example, `!aura` returns all actions that don't contain the string `aura` and filters out many framework-level actions.

IN THIS SECTION:

[Manually Override Server Responses](#)

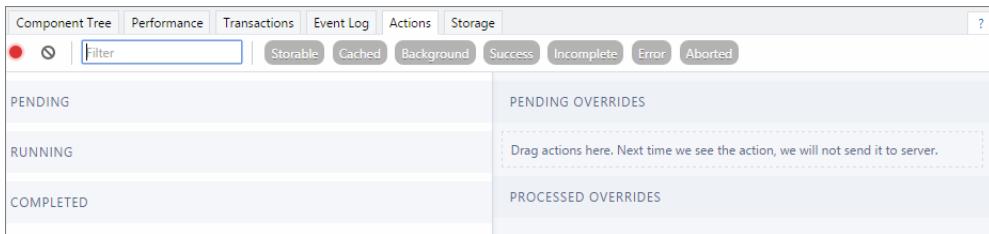
The Overrides panel on the right side of the Actions tab lets you manually tweak the server responses and investigate the fault tolerance of your app.

SEE ALSO:

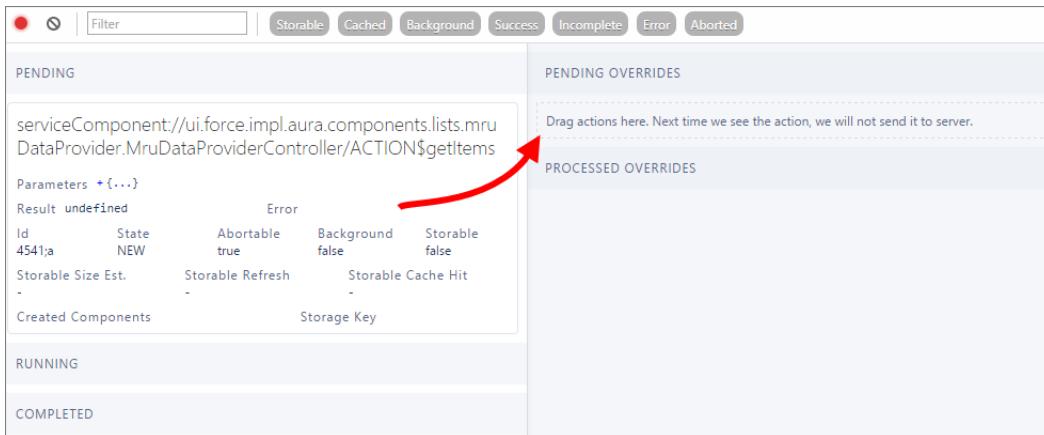
[Calling a Server-Side Action](#)

Manually Override Server Responses

The Overrides panel on the right side of the Actions tab lets you manually tweak the server responses and investigate the fault tolerance of your app.



Drag an action from the list on the left side to the PENDING OVERRIDES section.



The next time the same action is enqueued to be sent to the server, the framework won't send it. Instead, the framework mocks the response based on the override option that you choose. Here are the override options.

- Override the Result
- Error Response Next Time
- Drop the Action

Note: The same action means an action with the same name. The action parameters don't have to be identical.

IN THIS SECTION:

[Modify an Action Response](#)

Modify an action response in the Salesforce Lightning Inspector by changing one of the JSON object values and see how the UI is affected. The server returns a JSON object when you call a server-side action.

[Set an Error Response](#)

Your app should degrade gracefully when an error occurs so that users understand what happened or know how to proceed. Use the Salesforce Lightning Inspector to simulate an error condition and see how the user experience is affected.

[Drop an Action Response](#)

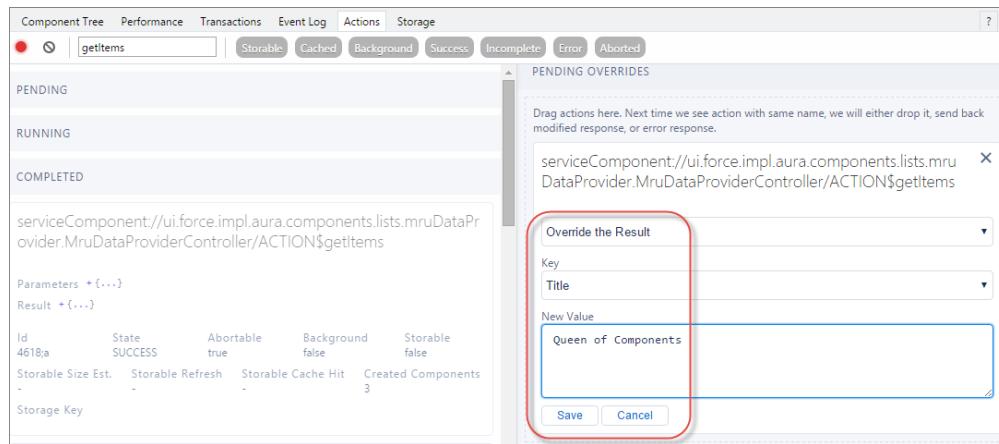
Your app should degrade gracefully when a server-side action times out or the response is dropped. Use the Salesforce Lightning Inspector to simulate a dropped action response and see how the user experience is affected.

Modify an Action Response

Modify an action response in the Salesforce Lightning Inspector by changing one of the JSON object values and see how the UI is affected. The server returns a JSON object when you call a server-side action.

1. Drag the action whose response you want to modify to the PENDING OVERRIDES section.

2. Select Override the Result in the drop-down list.
3. Select a response key to modify in the Key field.
4. Enter a modified value for the key in the New Value field.



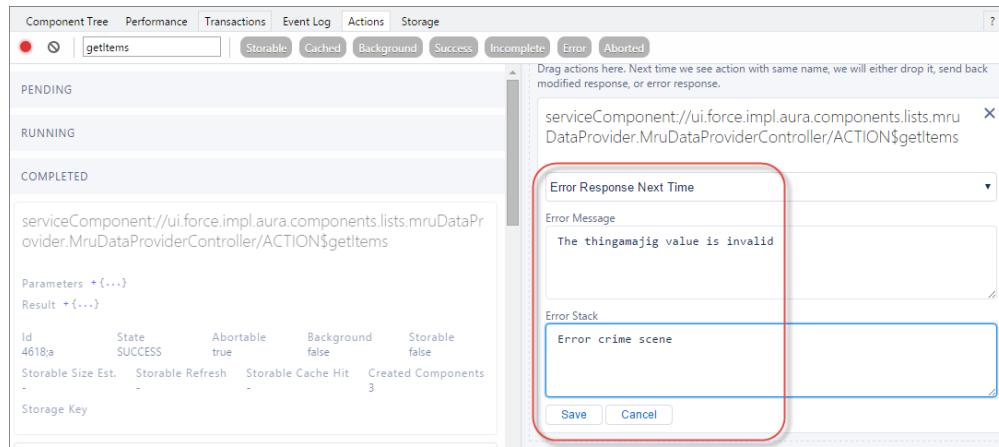
5. Click **Save**.
6. To trigger execution of the action, refresh the page.
The modified action response moves from the PENDING OVERRIDES section to the PROCESSED OVERRIDES section.
7. Note the UI change, if any, related to your change.

| NAME | TITLE |
|--------------|---------------------|
| Bertha Boxer | Queen of Components |

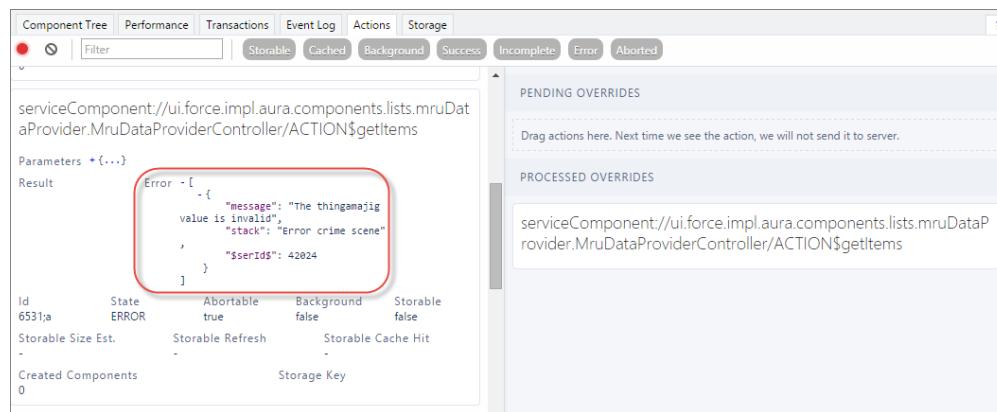
Set an Error Response

Your app should degrade gracefully when an error occurs so that users understand what happened or know how to proceed. Use the Salesforce Lightning Inspector to simulate an error condition and see how the user experience is affected.

1. Drag the action whose response you want to modify to the PENDING OVERRIDES section.
2. Select Error Response Next Time in the drop-down list.
3. Add an Error Message.
4. Add some text in the Error Stack field.



5. Click **Save**.
6. To trigger execution of the action, refresh the page.
 - The modified action response moves from the PENDING OVERRIDES section to the PROCESSED OVERRIDES section.
 - The action response displays in the COMPLETED section in the left panel with a **State** equals **ERROR**.



7. Note the UI change, if any, related to your change. The UI should handle errors by alerting the user or allowing them to continue using the app.
- To degrade gracefully, make sure that your action response callback handles an error response (`response.getState() === "ERROR"`).

SEE ALSO:

[Calling a Server-Side Action](#)

Drop an Action Response

Your app should degrade gracefully when a server-side action times out or the response is dropped. Use the Salesforce Lightning Inspector to simulate a dropped action response and see how the user experience is affected.

1. Drag the action whose response you want to modify to the PENDING OVERRIDES section.

2. Select Drop the Action in the drop-down list.

| Completed Actions | | | | |
|--------------------|------------------|-----------|--------------------|----------|
| Id | State | Abortable | Background | Storable |
| 2635:a | SUCCESS | true | false | false |
| Storable Size Est. | Storable Refresh | | Storable Cache Hit | |
| Created Components | Storage Key | | | |
| 0 | | | | |

3. To trigger execution of the action, refresh the page.

- The modified action response moves from the PENDING OVERRIDES section to the PROCESSED OVERRIDES section.
- The action response displays in the COMPLETED section in the left panel with a State equals INCOMPLETE.

| Completed Actions | | | | |
|--------------------|------------------|-----------|--------------------|----------|
| Id | State | Abortable | Background | Storable |
| 2830:a | INCOMPLETE | true | false | false |
| Storable Size Est. | Storable Refresh | | Storable Cache Hit | |
| Created Components | Storage Key | | | |
| 48 | | | | |

4. Note the UI change, if any, related to your change. The UI should handle the dropped action by alerting the user or allowing them to continue using the app.

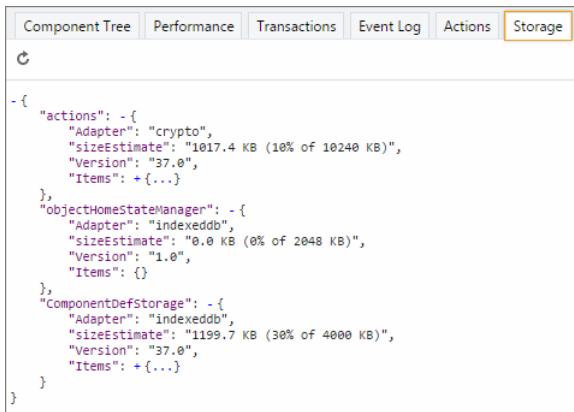
To degrade gracefully, make sure that your action response callback handles an incomplete response (`response.getState() === "INCOMPLETE"`).

SEE ALSO:

[Calling a Server-Side Action](#)

Storage Tab

This tab shows the client-side storage for Lightning applications. Actions marked as storable are stored in the `actions` store. Use this tab to analyze storage in the Salesforce mobile app and Lightning Experience.



The screenshot shows the 'Storage' tab of the Oracle Database Diagnostic Monitor. The tab bar includes 'Component Tree', 'Performance', 'Transactions', 'Event Log', 'Actions', and 'Storage'. The 'Storage' tab is selected and highlighted with an orange border. Below the tab bar, there is a search icon and a table containing JSON-like data. The data is as follows:

```
- {
  "actions": - {
    "Adapter": "crypto",
    "sizeEstimate": "1017.4 KB (10% of 10240 KB)",
    "Version": "37.0",
    "Items": +{...}
  },
  "objectHomeStateManager": - {
    "Adapter": "indexeddb",
    "sizeEstimate": "0.0 KB (0% of 2048 KB)",
    "Version": "1.0",
    "Items": {}
  },
  "ComponentDefStorage": - {
    "Adapter": "indexeddb",
    "sizeEstimate": "1199.7 KB (30% of 4000 KB)",
    "Version": "37.0",
    "Items": +{...}
  }
}
```

Log Messages

To help debug your client-side code, you can write output to the JavaScript console of a web browser using `console.log()` if your browser supports it..

For instructions on using the JavaScript console, refer to the instructions for your web browser.

CHAPTER 14 Performance

In this chapter ...

- [Performance Settings](#)
- [Fixing Performance Warnings](#)

There are a few settings and techniques that can help you to improve application performance.

Only enable debug mode for users who are actively debugging JavaScript. Salesforce is slower for users who have debug mode enabled.

SEE ALSO:

[Enable Debug Mode for Lightning Components](#)

Performance Settings

There are a few Setup settings that can help you to improve application performance.

IN THIS SECTION:

[Enable Secure Browser Caching](#)

Enable secure data caching in the browser to improve page reload performance by avoiding extra round trips to the server.

[Enable CDN to Load Applications Faster](#)

Load Lightning Experience and other apps faster by enabling Akamai's content delivery network (CDN) to serve the static content for Lightning Component framework. A CDN generally speeds up page load time, but it also changes the source domain that serves the files. If your company has IP range restrictions for content served from Salesforce, test thoroughly before enabling this setting.

Enable Secure Browser Caching

Enable secure data caching in the browser to improve page reload performance by avoiding extra round trips to the server.

This setting is selected by default.



Warning: Disabling secure and persistent browser caching has a significant negative performance impact on Lightning Experience.

Only disable in the following scenarios:

- Your company's policy doesn't allow browser caching, even if the data is encrypted.
- During development in a sandbox or Developer Edition org to see the effect of any code changes without needing to empty the secure cache.

To disable secure date caching:

1. From Setup, enter *Session* in the Quick Find box, and then select **Session Settings**.
2. Deselect the checkbox for "Enable secure and persistent browser caching to improve performance".
3. Click **Save**.

Enable CDN to Load Applications Faster

Load Lightning Experience and other apps faster by enabling Akamai's content delivery network (CDN) to serve the static content for Lightning Component framework. A CDN generally speeds up page load time, but it also changes the source domain that serves the files. If your company has IP range restrictions for content served from Salesforce, test thoroughly before enabling this setting.

CDNs improve the load time of static content by storing cached versions in multiple geographic locations. This setting turns on CDN delivery for the static JavaScript and CSS in the Lightning Component framework. It doesn't distribute your org's data or metadata in a CDN.

This setting is disabled by default for orgs created before the Winter '19 release, and enabled by default for new orgs and all new and existing communities. Lightning CDN for Communities can't be turned off and isn't configurable.

To enable the CDN:

1. From Setup, enter *Session* in the Quick Find box, and then select **Session Settings**.
2. Select the checkbox for "Enable Content Delivery Network (CDN) for Lightning Component framework".
3. Click **Save**.

If you experience any issues, ensure that `https://static.lightning.force.com` is added to any whitelist or firewall that your company operates and ask your IT department if your company's firewall blocks any Akamai CDN content. Do not use IP addresses for egress filtering as that can cause connection issues with `https://static.lightning.force.com`. IP addresses for `https://static.lightning.force.com` are dynamic and are not maintained in Salesforce's list of IP addresses to whitelist.

SEE ALSO:

[Salesforce Help: Options to Serve a Custom Domain](#)

[Knowledge Article: What are the Salesforce IP Addresses & Domains to whitelist?](#)

Fixing Performance Warnings

A few common performance anti-patterns in code prompt the framework to log warning messages to the browser console. Fix the warning messages to speed up your components!

The warnings display in the browser console only if you enabled debug mode.

IN THIS SECTION:

[`<aura:if>`—Clean Unrendered Body](#)

This warning occurs when you change the `isTrue` attribute of an `<aura:if>` tag from `true` to `false` in the same rendering cycle. The unrendered body of the `<aura:if>` must be destroyed, which is avoidable work for the framework that slows down rendering time.

[`<aura:iteration>`—Multiple Items Set](#)

This warning occurs when you set the `items` attribute of an `<aura:iteration>` tag multiple times in the same rendering cycle.

SEE ALSO:

[Enable Debug Mode for Lightning Components](#)

`<aura:if>`—Clean Unrendered Body

This warning occurs when you change the `isTrue` attribute of an `<aura:if>` tag from `true` to `false` in the same rendering cycle. The unrendered body of the `<aura:if>` must be destroyed, which is avoidable work for the framework that slows down rendering time.

Example

This component shows the anti-pattern.

```
<!--c:ifCleanUnrendered-->
<aura:component>
    <aura:attribute name="isVisible" type="boolean" default="true"/>
    <aura:handler name="init" value="{!this}" action=" {!c.init} "/>

    <aura:if isTrue=" {!v.isVisible}">
        <p>I am visible</p>
    </aura:if>
</aura:component>
```

Here's the component's client-side controller.

```
/* c:ifCleanUnrenderedController.js */
({
    init: function(cmp) {
        /* Some logic */
        cmp.set("v.isVisible", false); // Performance warning trigger
    }
})
```

When the component is created, the `isTrue` attribute of the `<aura:if>` tag is evaluated. The value of the `isVisible` attribute is `true` by default so the framework creates the body of the `<aura:if>` tag. After the component is created but before rendering, the `init` event is triggered.

The `init()` function in the client-side controller toggles the `isVisible` value from `true` to `false`. The `isTrue` attribute of the `<aura:if>` tag is now `false` so the framework must destroy the body of the `<aura:if>` tag. This warning displays in the browser console only if you enabled debug mode.

WARNING: [Performance degradation] markup://aura:if ["5:0"] in c:ifCleanUnrendered ["3:0"] needed to clear unrendered body.

Click the expand button beside the warning to see a stack trace for the warning.

| | |
|--|----------------------------------|
| AuraInstance.\$run\$ | @ aura_proddbug.js:18493 |
| Aura.\$Event\$.\$Events\$.fire\$ | @ aura_proddbug.js:8324 |
| Component.\$fireChangeEvent\$ | @ aura_proddbug.js:6203 |
| Component.set | @ aura_proddbug.js:6161 |
| init | @ ifCleanUnrendered.js:13 |
| Action.\$runDeprecated\$ | @ aura_proddbug.js:8666 |
| Component\$getActionCaller | @ aura_proddbug.js:6853 |
| Aura.\$Event\$.\$Events\$.executeHandlerIterator\$ | @ aura_proddbug.js:8296 |
| Aura.\$Event\$.\$Events\$.executeHandlers\$ | @ aura_proddbug.js:8274 |
| (anonymous) | @ aura_proddbug.js:8326 |

Click the link for the `ifCleanUnrendered` entry in the stack trace to see the offending line of code in the Sources pane of the browser console.

How to Fix the Warning

Reverse the logic for the `isTrue` expression. Instead of setting the `isTrue` attribute to `true` by default, set it to `false`. Set the `isTrue` expression to `true` in the `init()` method, if needed.

Here's the fixed component:

```
<!--c:ifCleanUnrenderedFixed-->
<aura:component>
    <!-- FIX: Change default to false.
            Update isTrue expression in controller instead. -->
    <aura:attribute name="isVisible" type="boolean" default="false"/>
    <aura:handler name="init" value="{!this}" action=" {!c.init}"/>

    <aura:if isTrue=" {!v.isVisible}">
        <p>I am visible</p>
    </aura:if>
</aura:component>
```

Here's the fixed controller:

```
/* c:ifCleanUnrenderedFixedController.js */
({
    init: function(cmp) {
        // Some logic
        // FIX: set isVisible to true if logic criteria met
        cmp.set("v.isVisible", true);
    }
})
```

SEE ALSO:

[Enable Debug Mode for Lightning Components](#)

<aura:iteration>—Multiple Items Set

This warning occurs when you set the `items` attribute of an `<aura:iteration>` tag multiple times in the same rendering cycle.

There's no easy and performant way to check if two collections are the same in JavaScript. Even if the old value of `items` is the same as the new value, the framework deletes and replaces the previously created body of the `<aura:iteration>` tag.

Example

This component shows the anti-pattern.

```
<!--c:iterationMultipleItemsSet-->
<aura:component>
    <aura:attribute name="groceries" type="List"
        default="[ 'Eggs', 'Bacon', 'Bread' ]"/>

    <aura:handler name="init" value="{!this}" action=" {!c.init} "/>

    <aura:iteration items=" {!v.groceries}" var="item">
        <p>{!item}</p>
    </aura:iteration>
</aura:component>
```

Here's the component's client-side controller.

```
/* c:iterationMultipleItemsSetController.js */
({
    init: function(cmp) {
        var list = cmp.get('v.groceries');
        // Some logic
        cmp.set('v.groceries', list); // Performance warning trigger
    }
})
```

When the component is created, the `items` attribute of the `<aura:iteration>` tag is set to the default value of the `groceries` attribute. After the component is created but before rendering, the `init` event is triggered.

The `init()` function in the client-side controller sets the `groceries` attribute, which resets the `items` attribute of the `<aura:iteration>` tag. This warning displays in the browser console only if you enabled debug mode.

```
WARNING: [Performance degradation] markup://aura:iteration [id:5:0] in
c:iterationMultipleItemsSet ["3:0"]
had multiple items set in the same Aura cycle.
```

Click the expand button beside the warning to see a stack trace for the warning.

| | |
|---|--|
| AuraInstance.\$run\$ | @ aura_proddebug.js:18493 |
| Aura.\$Event\$.Event\$.fire\$ | @ aura_proddebug.js:8324 |
| Component.\$fireChangeEvent\$ | @ aura_proddebug.js:6203 |
| Component.set | @ aura_proddebug.js:6161 |
| init | @ iterationMultipleItemsSet.js:14 |
| Action.\$unDeprecated\$ | @ aura_proddebug.js:8866 |
| Component\$getActionCaller | @ aura_proddebug.js:6853 |
| Aura.\$Event\$.Event\$.executeHandlerIterator\$ | @ aura_proddebug.js:8296 |
| Aura.\$Event\$.Event\$.executeHandlers\$ | @ aura_proddebug.js:8274 |
| (anonymous) | @ aura_proddebug.js:8326 |

Click the link for the `iterationMultipleItemsSet` entry in the stack trace to see the offending line of code in the Sources pane of the browser console.

How to Fix the Warning

Make sure that you don't modify the `items` attribute of an `<aura:iteration>` tag multiple times. The easiest solution is to remove the default value for the `groceries` attribute in the markup. Set the value for the `groceries` attribute in the controller instead.

The alternate solution is to create a second attribute whose only purpose is to store the default value. When you've completed your logic in the controller, set the `groceries` attribute.

Here's the fixed component:

```
<!--c:iterationMultipleItemsSetFixed-->
<aura:component>
    <!-- FIX: Remove the default from the attribute -->
    <aura:attribute name="groceries" type="List" />
    <!-- FIX (ALTERNATE): Create a separate attribute containing the default -->
    <aura:attribute name="groceriesDefault" type="List"
        default="['Eggs', 'Bacon', 'Bread']"/>

    <aura:handler name="init" value="{!this}" action=" {!c.init} "/>

    <aura:iteration items=" {!v.groceries}" var="item">
        <p>{!item}</p>
    </aura:iteration>
</aura:component>
```

Here's the fixed controller:

```
/* c:iterationMultipleItemsSetFixedController.js */
({
    init: function(cmp) {
        // FIX (ALTERNATE) if need to set default in markup
        // use a different attribute
        // var list = cmp.get('v.groceriesDefault');
        // FIX: Set the value in code
        var list = ['Eggs', 'Bacon', 'Bread'];
```

```
// Some logic  
cmp.set('v.groceries', list);  
}  
})
```

SEE ALSO:

[Enable Debug Mode for Lightning Components](#)

CHAPTER 15 Reference

In this chapter ...

- [Component Library](#)
- [System Tag Reference](#)

This section contains links to reference documentation.

Note that the the Aura Components programming model provides a subset of what's available in the open-source Aura framework, in addition to components and events that are specific to Salesforce.

Component Library

Explore the look and feel of components to speed up your app development.

To see the complete collection of Lightning components available in your Salesforce organization, log in and navigate to the Component Library.

- <https://<myDomain>.lightning.force.com/componentReference/suite.app>

You can also use the Component Library without logging in to Salesforce.

- <https://developer.salesforce.com/docs/component-library>



For JavaScript API documentation, see the Aura Reference app.

- <https://<myDomain>.lightning.force.com/auradocs/reference.app>
- <http://documentation.auraframework.org/>

If you're using Aura components on the Salesforce Platform, use only the JavaScript API section of the Aura Reference app. The other sections are for open-source developers and features may change.

IN THIS SECTION:

[Aura Reference Doc App](#)

[Differences Between Documentation Sites](#)

Here's a breakdown of the differences between the Component Library, the reference section of this developer guide, and the Aura Reference app.

Aura Reference Doc App

Explore the look and feel of Lightning components in the Component Library at

<https://<myDomain>.lightning.force.com/componentReference/suite.app> where <myDomain> is the name of your custom Salesforce domain.

You can also continue to use the reference doc app, which includes reference information, as well as the JavaScript API. Access the app at:

<https://<myDomain>.lightning.force.com/auradocs/reference.app>, where <myDomain> is the name of your custom Salesforce domain.

Differences Between Documentation Sites

Here's a breakdown of the differences between the Component Library, the reference section of this developer guide, and the Aura Reference app.

The Component Library is undergoing major enhancements to achieve parity with the other legacy sites. Meanwhile, we recommend that you refer to the respective sites for your documentation needs.

| | Component Library | Aura Reference App | Reference Section in Lightning Aura Components Developer Guide |
|--|-----------------------|--|--|
| Component documentation and code samples | ✓ (Documentation tab) | ✓ (Overview tab) | |
| Interactive examples | ✓ (Usage tab) | ✓ (Examples tab is not available for components in <code>lightning</code> namespace) | |
| Lightning Design System support | ✓ | | |
| Components in custom namespaces and packages | ✓ | ✓ | |
| JavaScript API | | ✓ | |
| System tags | | | ✓ (<code>aura:method</code> , <code>aura:set</code> , etc.) |
| Event documentation | ✓ | | |
| System event documentation | ✓ | | |
| Interface documentation | ✓ | ✓ | |

Components in custom namespaces display both global and non-global attributes and methods. Components in managed and unmanaged packages display global attributes and methods only.

System Tag Reference

System tags represent framework definitions and are not available in the Component Library.

IN THIS SECTION:

[aura:application](#)

An app is a special top-level component whose markup is in a `.app` resource.

[aura:dependency](#)

The `<aura:dependency>` tag enables you to declare dependencies, which improves their discoverability by the framework.

[aura:event](#)

An event is represented by the `aura:event` tag, which has the following attributes.

[aura:interface](#)

Interfaces determine a component's shape by defining its attributes. Implement an interface to allow a component to be used in different contexts, such as on a record page or in Lightning App Builder.

[aura:method](#)

Use `<aura:method>` to define a method as part of a component's API. This enables you to directly call a method in a component's client-side controller instead of firing and handling a component event. Using `<aura:method>` simplifies the code needed for a parent component to call a method on a child component that it contains.

[aura:set](#)

Use `<aura:set>` in markup to set the value of an attribute inherited from a component or event.

aura:application

An app is a special top-level component whose markup is in a `.app` resource.

The markup looks similar to HTML and can contain components as well as a set of supported HTML tags. The `.app` resource is a standalone entry point for the app and enables you to define the overall application layout, style sheets, and global JavaScript includes. It starts with the top-level `<aura:application>` tag, which contains optional system attributes. These system attributes tell the framework how to configure the app.

| System Attribute | Type | Description |
|--------------------------|-----------|--|
| <code>access</code> | String | Indicates whether the app can be extended by another app outside of a namespace. Possible values are <code>public</code> (default), and <code>global</code> . |
| <code>controller</code> | String | The server-side controller class for the app. The format is <code>namespace.myController</code> . |
| <code>description</code> | String | A brief description of the app. |
| <code>extends</code> | Component | The app to be extended, if applicable. For example, <code>extends="namespace:yourApp"</code> . |
| <code>extensible</code> | Boolean | Indicates whether the app is extensible by another app. Defaults to <code>false</code> . |
| <code>implements</code> | String | A comma-separated list of interfaces that the app implements. |
| <code>template</code> | Component | The name of the template used to bootstrap the loading of the framework and the app. The default value is <code>aura:template</code> . You can customize the template by creating your own component that extends the default template. For example: <code><aura:component extends="aura:template" ... ></code> |

| System Attribute | Type | Description |
|------------------|---------|---|
| tokens | String | A comma-separated list of tokens bundles for the application. For example, <code>tokens="ns:myAppTokens"</code> . Tokens make it easy to ensure that your design is consistent, and even easier to update it as your design evolves. Define the token values once and reuse them throughout your application. |
| useAppcache | Boolean | Deprecated. Browser vendors have deprecated AppCache, so we followed their lead. Remove the <code>useAppcache</code> attribute in the <code><aura:application></code> tag of your standalone apps (.app resources) to avoid cross-browser support issues due to deprecation by browser vendors. If you don't currently set <code>useAppcache</code> in an <code><aura:application></code> tag, you don't have to do anything because the default value of <code>useAppcache</code> is <code>false</code> . |

`aura:application` also includes a `body` attribute defined in a `<aura:attribute>` tag. Attributes usually control the output or behavior of a component, but not the configuration information in system attributes.

| Attribute | Type | Description |
|-----------|--------------|--|
| body | Component [] | The body of the app. In markup, this is everything in the body of the tag. |

SEE ALSO:

- [Creating Apps](#)
- [Using the AppCache](#)
- [Application Access Control](#)

aura:dependency

The `<aura:dependency>` tag enables you to declare dependencies, which improves their discoverability by the framework.

The framework automatically tracks dependencies between definitions, such as components, defined in markup. This enables the framework to send the definitions to the browser. However, if a component's JavaScript code dynamically instantiates another component or fires an event that isn't directly referenced in the component's markup, use `<aura:dependency>` in the component's markup to explicitly tell the framework about the dependency. Adding the `<aura:dependency>` tag ensures that a definition, such as a component, and its dependencies are sent to the client, when needed.

For example, adding this tag to a component marks the `sampleNamespace:sampleComponent` component as a dependency.

```
<aura:dependency resource="markup://sampleNamespace:sampleComponent" />
```

Add this tag to component markup to mark the event as a dependency.

```
<aura:dependency resource="markup://force:navigateToComponent" type="EVENT"/>
```

Use the `<aura:dependency>` tag if you fire an event in JavaScript code and you're not registering the event in component markup using `<aura:registerEvent>`. Using an `<aura:registerEvent>` tag is the preferred approach.

The `<aura:dependency>` tag includes these system attributes.

| System Attribute | Description |
|------------------|---|
| resource | <p>The resource that the component depends on, such as a component or event. For example, <code>resource="markup://sampleNamespace:sampleComponent"</code> refers to the <code>sampleComponent</code> in the <code>sampleNamespace</code> namespace.</p> <p> Note: Using an asterisk (*) for wildcard matching is deprecated. Instead, add an <code><aura:dependency></code> tag for each resource that's not directly referenced in the component's markup. Wildcard matching can cause save validation errors when no resources match. Wildcard matching can also slow page load time because it sends more definitions than needed to the client.</p> |
| type | <p>The type of resource that the component depends on. The default value is <code>COMPONENT</code>.</p> <p> Note: Using an asterisk (*) for wildcard matching is deprecated. Instead, add an <code><aura:dependency></code> tag for each resource that's not directly referenced in the component's markup. Be as selective as possible in the types of definitions that you send to the client.</p> <p>The most commonly used values are:</p> <ul style="list-style-type: none"> • <code>COMPONENT</code> • <code>EVENT</code> • <code>INTERFACE</code> • <code>APPLICATION</code> <p>Use a comma-separated list for multiple types; for example: <code>COMPONENT, APPLICATION</code>.</p> |

SEE ALSO:

[Dynamically Creating Components](#)

[Fire Component Events](#)

[Fire Application Events](#)

aura:event

An event is represented by the `aura:event` tag, which has the following attributes.

| Attribute | Type | Description |
|-------------|-----------|--|
| access | String | Indicates whether the event can be extended or used outside of its own namespace. Possible values are <code>public</code> (default), and <code>global</code> . |
| description | String | A description of the event. |
| extends | Component | The event to be extended. For example, <code>extends="namespace:myEvent"</code> . |

| Attribute | Type | Description |
|-----------|--------|---|
| type | String | Required. Possible values are COMPONENT or APPLICATION. |

SEE ALSO:

- [Communicating with Events](#)
- [Event Access Control](#)

aura:interface

Interfaces determine a component's shape by defining its attributes. Implement an interface to allow a component to be used in different contexts, such as on a record page or in Lightning App Builder.

The `aura:interface` tag has the following optional attributes.

| Attribute | Type | Description |
|-------------|-----------|--|
| access | String | Indicates whether the interface can be extended or used outside of its own namespace. Possible values are <code>public</code> (default), and <code>global</code> . |
| description | String | A description of the interface. |
| extends | Component | The comma-separated list of interfaces to be extended. For example, <code>extends="namespace:intfB"</code> . |

SEE ALSO:

- [Interfaces](#)
- [Interface Access Control](#)

aura:method

Use `<aura:method>` to define a method as part of a component's API. This enables you to directly call a method in a component's client-side controller instead of firing and handling a component event. Using `<aura:method>` simplifies the code needed for a parent component to call a method on a child component that it contains.

The `<aura:method>` tag has these system attributes.

| Attribute | Type | Description |
|-----------|------------|--|
| name | String | The method name. Use the method name to call the method in JavaScript code. For example: <code>cmp.sampleMethod(param1);</code> |
| action | Expression | The client-side controller action to execute. For example: <code>action="{!c.sampleAction}"</code> |

| Attribute | Type | Description |
|-------------|--------|--|
| | | <code>sampleAction</code> is an action in the client-side controller. If you don't specify an <code>action</code> value, the controller action defaults to the value of the method name. |
| access | String | The access control for the method. Valid values are: <ul style="list-style-type: none"> • public—Any component in the same namespace can call the method. This is the default access level. • global—Any component in any namespace can call the method. |
| description | String | The method description. |

Declaring Parameters

An `<aura:method>` can optionally include parameters. Use an `<aura:attribute>` tag within an `<aura:method>` to declare a parameter for the method. For example:

```
<aura:method name="sampleMethod" action="{!!c.doAction}"
  description="Sample method with parameters">
  <aura:attribute name="param1" type="String" default="parameter 1"/>
  <aura:attribute name="param2" type="Object" />
</aura:method>
```

 **Note:** You don't need an `access` system attribute in the `<aura:attribute>` tag for a parameter.

Creating a Handler Action

This handler action shows how to access the arguments passed to the method.

```
({
  doAction : function(cmp, event) {
    var params = event.getParam('arguments');
    if (params) {
      var param1 = params.param1;
      // add your code here
    }
  }
})
```

Retrieve the arguments using `event.getParam('arguments')`. It returns an object if there are arguments or an empty array if there are no arguments.

Returning a Value

`aura:method` executes synchronously.

- A synchronous method finishes executing before it returns. Use the `return` statement to return a value from synchronous JavaScript code. See [Return Result for Synchronous Code](#).

- An asynchronous method may continue to execute after it returns. Use a callback to return a value from asynchronous JavaScript code. See [Return Result for Asynchronous Code](#).

SEE ALSO:

[Calling Component Methods](#)

[Component Events](#)

aura:set

Use `<aura:set>` in markup to set the value of an attribute inherited from a component or event.

IN THIS SECTION:

[Setting Attributes Inherited from a Super Component](#)

[Setting Attributes on a Component Reference](#)

[Setting Attributes Inherited from an Interface](#)

Setting Attributes Inherited from a Super Component

Use `<aura:set>` in the markup of a sub component to set the value of an inherited attribute.

Let's look at an example. Here is the `c:setTagSuper` component.

```
<!--c:setTagSuper-->
<aura:component extensible="true">
    <aura:attribute name="address1" type="String" />
    setTagSuper address1: {!v.address1}<br/>
</aura:component>
```

`c:setTagSuper` outputs:

```
setTagSuper address1:
```

The `address1` attribute doesn't output any value yet as it hasn't been set.

Here is the `c:setTagSub` component that extends `c:setTagSuper`.

```
<!--c:setTagSub-->
<aura:component extends="c:setTagSuper">
    <aura:set attribute="address1" value="808 State St" />
</aura:component>
```

`c:setTagSub` outputs:

```
setTagSuper address1: 808 State St
```

`sampleSetTagExc:setTagSub` sets a value for the `address1` attribute inherited from the super component, `c:setTagSuper`.



Warning: This usage of `<aura:set>` works for components and abstract components, but it doesn't work for interfaces. For more information, see [Setting Attributes Inherited from an Interface](#) on page 477.

If you're using a component by making a reference to it in your component, you can set the attribute value directly in the markup. For example, `c:setTagSuperRef` makes a reference to `c:setTagSuper` and sets the `address1` attribute directly without using `aura:set`.

```
<!--c:setTagSuperRef-->
<aura:component>
    <c:setTagSuper address1="1 Sesame St" />
</aura:component>
```

`c:setTagSuperRef` outputs:

```
setTagSuper address1: 1 Sesame St
```

SEE ALSO:

[Component Body](#)

[Inherited Component Attributes](#)

[Setting Attributes on a Component Reference](#)

Setting Attributes on a Component Reference

When you include another component, such as `<ui:button>`, in a component, we call that a component reference to `<ui:button>`. You can use `<aura:set>` to set an attribute on the component reference. For example, if your component includes a reference to `<ui:button>`:

```
<ui:button label="Save">
    <aura:set attribute="buttonTitle" value="Click to save the record"/>
</ui:button>
```

This is equivalent to:

```
<ui:button label="Save" buttonTitle="Click to save the record" />
```

The latter syntax without `aura:set` makes more sense in this simple example. You can also use this simpler syntax in component references to set values for attributes that are inherited from parent components.

`aura:set` is more useful when you want to set markup as the attribute value. For example, this sample specifies the markup for the `else` attribute in the `aura:if` tag.

```
<aura:component>
    <aura:attribute name="display" type="Boolean" default="true"/>
    <aura:if isTrue="={!v.display}">
        Show this if condition is true
        <aura:set attribute="else">
            <ui:button label="Save" press=" {!c.saveRecord} " />
        </aura:set>
    </aura:if>
</aura:component>
```

SEE ALSO:

[Setting Attributes Inherited from a Super Component](#)

Setting Attributes Inherited from an Interface

To set the value of an attribute inherited from an interface, redefine the attribute in the component and set its default value. Let's look at an example with the `c:myIntf` interface.

```
<!--c:myIntf-->
<aura:interface>
    <aura:attribute name="myBoolean" type="Boolean" default="true" />
</aura:interface>
```

This component implements the interface and sets `myBoolean` to `false`.

```
<!--c:myIntfImpl-->
<aura:component implements="c:myIntf">
    <aura:attribute name="myBoolean" type="Boolean" default="false" />

    <p>myBoolean: {!v.myBoolean}</p>
</aura:component>
```

INDEX

A

Apex

- API calls [411](#)
- custom objects [403](#)
- deleting records [408](#)
- Lightning components [412](#)
- records [403](#)
- saving records [407](#)
- standard objects [403](#)

API calls

application, creating

Aura components

- action override [158–161](#)
- interfaces [160](#)
- Lightning Experience [158–160](#)
- markup [160](#)
- packaging [161](#)
- Salesforce [158–160](#)

Aura components interfaces

- force:hasRecordId [160](#)
- force:hasSObjectName [160](#)
- lightning:actionOverride [160](#)

authentication

- guest access [239](#)

C

CDN

change handling

Communities

Communities Lightning components

- overview [187](#)

Community Builder

- Aura components overview [187](#)
- configuring custom components [187](#)
- content layouts [195](#)
- profile menu [194](#)
- search [194](#)
- theme layouts [188](#)

Component bundles

- configuring design resources for Lightning Pages [180](#)
- configuring for Community Builder [187](#)
- configuring for Lightning App Builder [172, 174, 186](#)
- configuring for Lightning Experience Record Home pages [186](#)
- configuring for Lightning Experience record pages [174](#)

Component bundles (*continued*)

- configuring for Lightning pages [172, 174, 186](#)
- create dynamic picklists for components on Lightning Pages [180](#)
- tips for configuring for Lightning App Builder [186](#)

Components

- action override [158–161](#)
- actions [148, 151, 153](#)
- custom app integration [226](#)
- flow, finish behavior [219](#)
- flow, resume [220](#)
- markup [160](#)
- packaging [161](#)
- tabs [148](#)
- using [145, 148, 151, 153, 158, 197, 434](#)

CRUD access

Custom Actions

- components [151, 153](#)

custom content layouts

- creating for Community Builder [195](#)

Custom Lightning page template component

- best practices [184](#)

custom profile menu

- creating for Community Builder [194](#)

custom search

- creating for Community Builder [194](#)

Custom Tabs

- components [148](#)

custom theme layouts

- creating for Community Builder [188](#)

D

data access

Debug

- JavaScript [444](#)

deleteRecord

dependency

Developer Edition organization, sign up

E

error handling

errors

eval() function limitations

Events

- Salesforce mobile and Lightning Experience demo [10](#)

- Salesforce mobile demo [13, 17](#)

Index

example 428

F

Field-level security 406

G

getNewRecord 418
guest access 239
guest user flows 191

L

Lightning App Builder
configuring custom components 172, 174, 186
configuring design resources 180
create dynamic picklists for components 180
creating a custom page template 181, 184
creating a width-aware component 184
Lightning components
custom app integration 226
Lightning Experience 148–149, 151, 153
overview 172
Salesforce 148, 151, 153
Salesforce app 150

Lightning Components for Visualforce 235, 239

Lightning Container

javascript 241
messaging 243, 247, 252

Lightning Data Service

create record 418
delete record 421
handling record changes 424
load record 414
saveRecord 415

Lightning Experience

add Lightning components 149

Lightning Out

beta 240
Connected App 235
considerations 240
CORS 235
events 240
limitations 240
OAuth 235
requirements 235
SLDS 240
styling 240

lightning:flexipageRegionInfo 184

lightning:formattedUrl 171

lightning:hasPageReference 162

lightning:isUrlAddressable 162

lightning:navigation 162, 171

lightning:ui:outputUrl 171

M

MIME types permitted 327

N

Navigation
Page Definitions 165

Node.js 234

O

OAuth 238

P

Packaging
action override 161

Performance

caching 461
CDN 461
settings 461

Prerequisites 9

R

Rich Publisher Apps 226

S

Salesforce app
add Lightning components 150

SaveRecordResult 432

SharePoint 234

Standard Actions

Lightning components 158–161
override 158–161
packaging 161
standard controller 413, 425–426, 428, 432
supported objects 426

T

Testing
components 435–436, 438–440, 442
mode 436, 438
troubleshooting 245, 248, 250, 253

V

Visualforce 232

Index

W

Width-aware Aura component [184](#)