State Management in Blazor

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Level: Beginner

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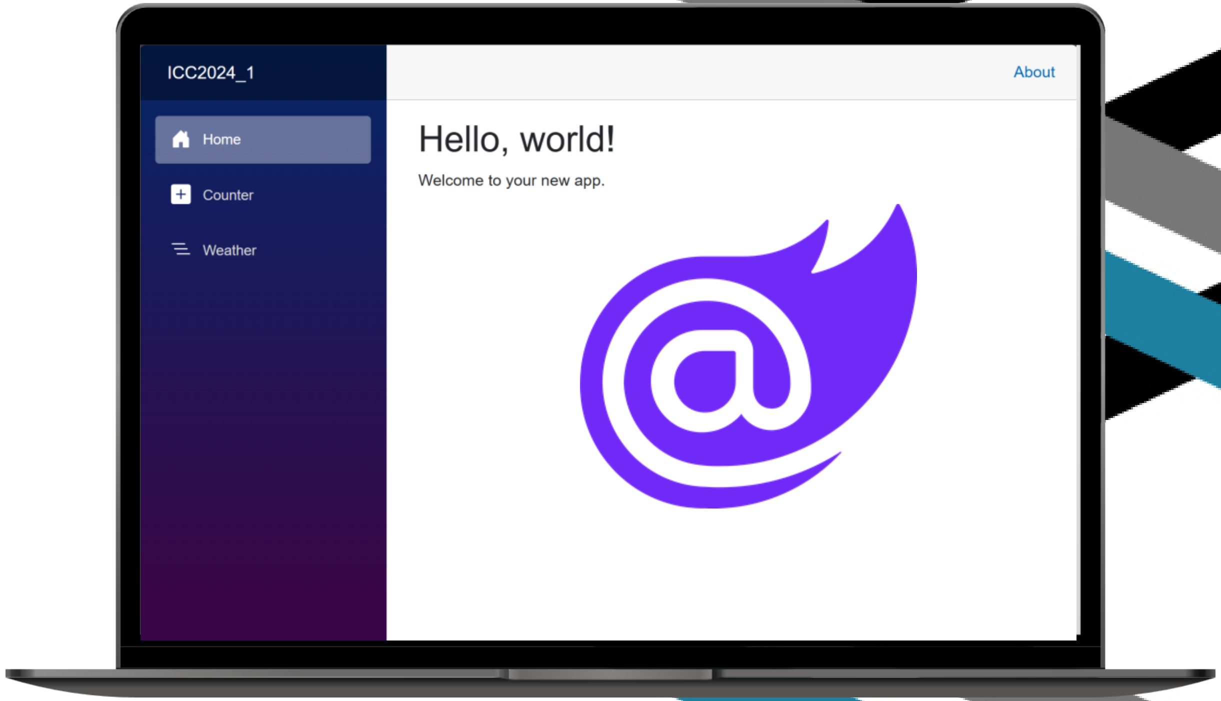
Goals of the Session

- **Identify types of state management in Blazor and the tools and patterns used**
- **Learn about how the Blazor rendering modes and render cycles impact state management**
- **Identify larger architectural patterns and practical examples for managing state in a Blazor application**

What is Blazor?

- Modern full-stack web framework
- Built on Asp.NET Core and Modern .NET
- Released with .NET Core 3.1 in 2018
- Component-based reactive framework
- Static and dynamic Server-Side rendering
- Client WebAssembly SPA applications or individual components
- High productivity with a single unifying language and framework



Hello, world!

Welcome to your new app.

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Bl@zing Shipments

As we look at this web app, consider the following questions:

- Where are the pages being rendered?
- How does it know what data to load?
- Are the pages comprised of a single component, or many?
- How does the site respond to user interaction?
- If we needed to store data, where would we store it?

What is State Management?

- **“State management refers to the management of the state of one or more user interface controls such as text fields, submit buttons, radio buttons, etc. in a graphical user interface.”**
    - ***from Wikipedia (based on redux.js.org)***

Types of State in Web Development

- **Component State**
- **Application State**
- **User/Session State**
- **Persistent State**

Component State

- Stored in component fields/properties or a model object
- Bound to HTML input and display elements
- Unsaved changes are lost on navigation/refresh

```
<p role="status">Current count: @currentCount</p>
<button class="btn btn-primary"
        @onclick="IncrementCount">Click me</button>
@code {
    private int currentCount = 0;
    private void IncrementCount() => currentCount++;
}
```

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Component State

- Custom razor syntax for binding

```
<input type="text" @bind="fieldOrProp" />
```

- fires with the onchange event
- Change the event with `@bind:event="oninput"`
- Add a change handler method with `@bind:after="HandlerMethod"`
- For Razor Components, the syntax changes to bind to parameters: `<TestComponent @bind-ParameterName="fieldOrProp" />`
- Can also use `@bind:get=“value“@bind:set=“HandlerMethod”`

Application State

- State shared across components using
  - Parameters
  - CascadingValues
  - EventCallbacks
  - Service Classes

Application State: Parameters

- **C# public properties with [Parameter] attribute on a child component**

```
MapView.razor

[Parameter]
public double? Latitude { get; set; }

[Parameter]
public double? Longitude { get; set; }
```

- **In consuming (parent) class markup, parameters display like HTML attributes with capital letters**

```
<MapView Latitude="@shipment.Latitude" Longitude="@shipment.Longitude">
   <Map>
      <Basemap>
         <BasemapStyle Name="BasemapStyleName.ArcgisStreets"/>
      </Basemap>
   </Map>
</MapView>
```

Application State: Cascading Values

- Wrap child components with markup tags

```
<CascadingValue Value=" @User" Name="CurrentUser">
  <ProfileSelector />
</CascadingValue>
```

- All descendant components can receive the values as properties with the [CascadingParameter] attribute

```
[CascadingParameter(Name="CurrentUser")]
public ApplicationUser? CurrentUser { get; set; }
```

- Cascading values can also be defined globally in the Dependency Injection startup code.

```
builder.Services.AddCascadingValue("HomeCompany", sp => new Company { Id = 1, Name = "Home" });
```

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Application State: EventCallbacks

- A type of Parameter
- Async-supporting Event triggers

```
[Parameter]
public EventCallback<LayerViewCreateEvent> OnLayerViewCreate { get; set; }
```

- Bind to a parent component method instead of field or property

```
<MapView  OnLayerViewCreate="OnLayerViewCreate">
   <Map>
      <FeatureLayer OutFields="@(["*"])">
         <PortalItem PortalItemId="234d2e3f6f554e0e84757662469c26d3" />
      </FeatureLayer>
   </Map>
   </Extent>
</ MapView>
```

```
private async Task OnLayerViewCreate(LayerViewCreateEvent createEvent)
{
   if (createEvent.Layer is FeatureLayer)
   {
      // query the feature service
   }
}
```

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Application State: EventCallbacks

- **Parent components may receive changes (2-way binding) from a parameter**

```
InputText.razor

[Parameter]
public double? Value { get; set; }

[Parameter]
public EventCallback<string> ValueChanged { get; set; }
```

```
Parent.razor

<InputText @bind-Value="boundField"></ InputText>
```

Application State: Service Classes

- Any C# Class can be injected via Property Injection
  - In Razor Markup

```
@page "/order"
@inject StateManagementService StateManagementService
```

  - Or in C#

```
@code {
      [Inject]
      private StateManagementService? StateManager { get; set; }
}
```

- Allows offloading State Management logic from Pages and Components
- Share state between Components
- Use traditional .NET events/EventHandlers to notify different components about changes

User/Session State

- Authentication
- Authorization
- Profile
- Records
- Work Progress

User/Session State

- **Browser Persistence**
  - **Query String** https://blazingshipments.com?id=12345
  - **Tokens**
  - **Cookies**
  - **localStorage**
  - **sessionStorage**
  - **indexedDb**
- **Server Persistence**
  - **Persistent Cache (e.g., Redis)**
  - **Database**

Persistent State: Browser Storage

- **localStorage**
  - persists when tab/browser is closed, across multiple tabs
- **sessionStorage**
  - isolates data between tabs to prevent issues, data also is lost when tab is closed
- **IndexedDb**
  - Object-store structured database
  - Create an object store with a key path (aka ID) or a key generator
  - Also supports indexes
  - Transaction-scoped access: add, put (update), get, delete
- All require JavaScript or NuGet JS wrappers to interact.
- Available in “Interactive Render Modes”

Persistent State: Server Storage

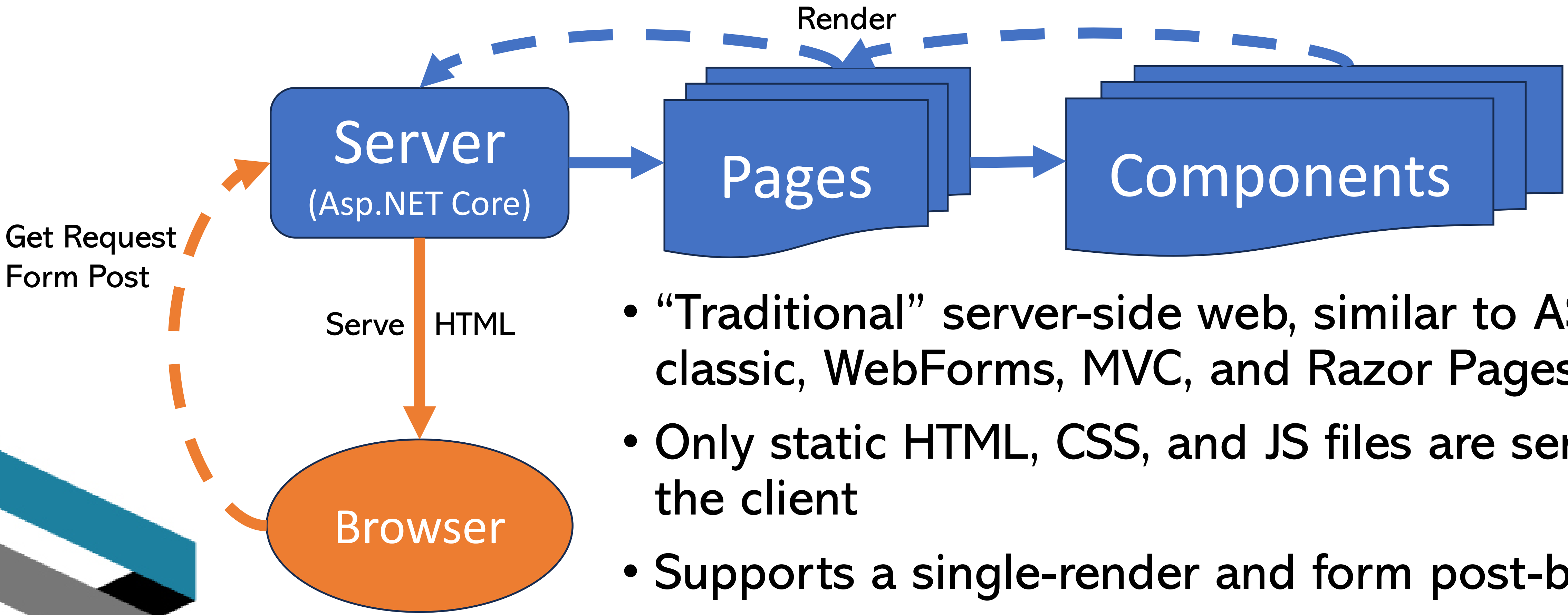
- MemoryCache
- Redis cache
- HybridCache
- Database
- Only available from “Interactive Server” or via web API calls.

Blazor Component Render Modes

- Static Server Mode
- Interactive Server Mode
- Interactive WebAssembly Mode
- Interactive Auto Mode
- Blazor Hybrid *

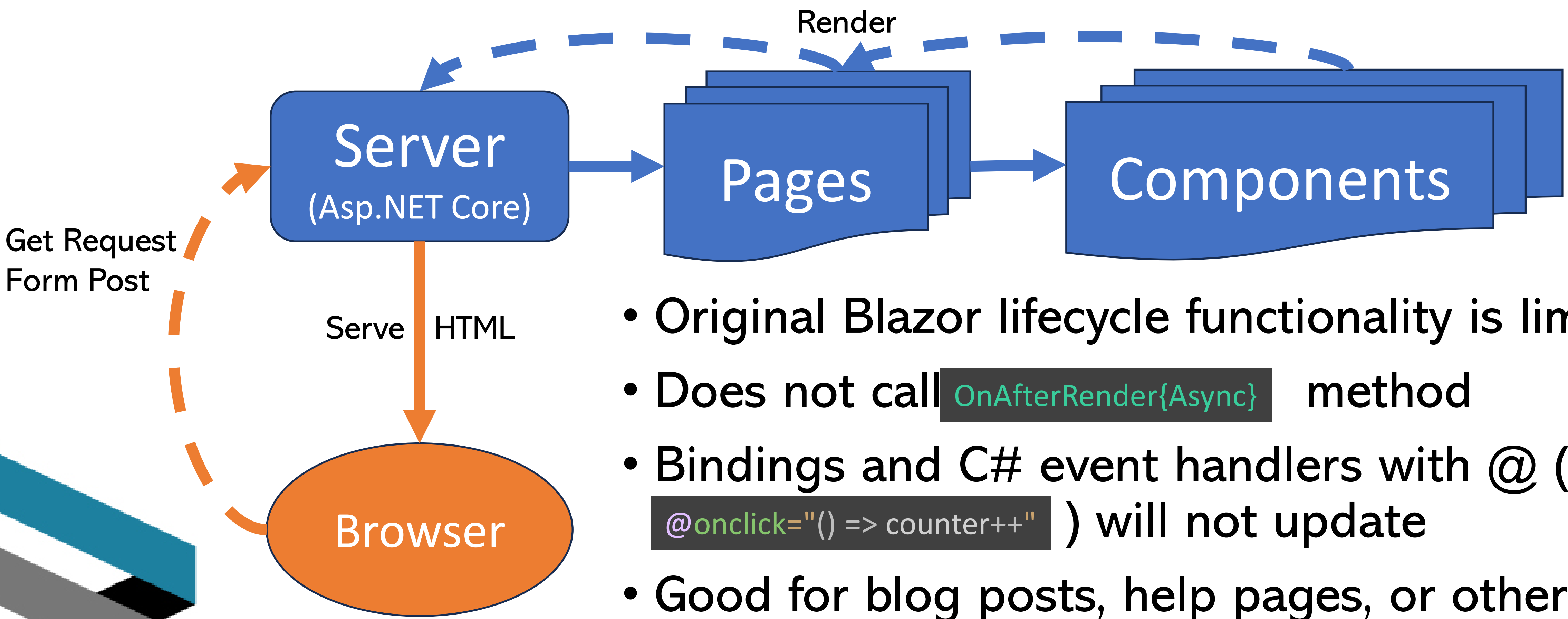
** technically a “Blazor Hosting Model”, not a render mode*

Blazor Render Modes: Static Server



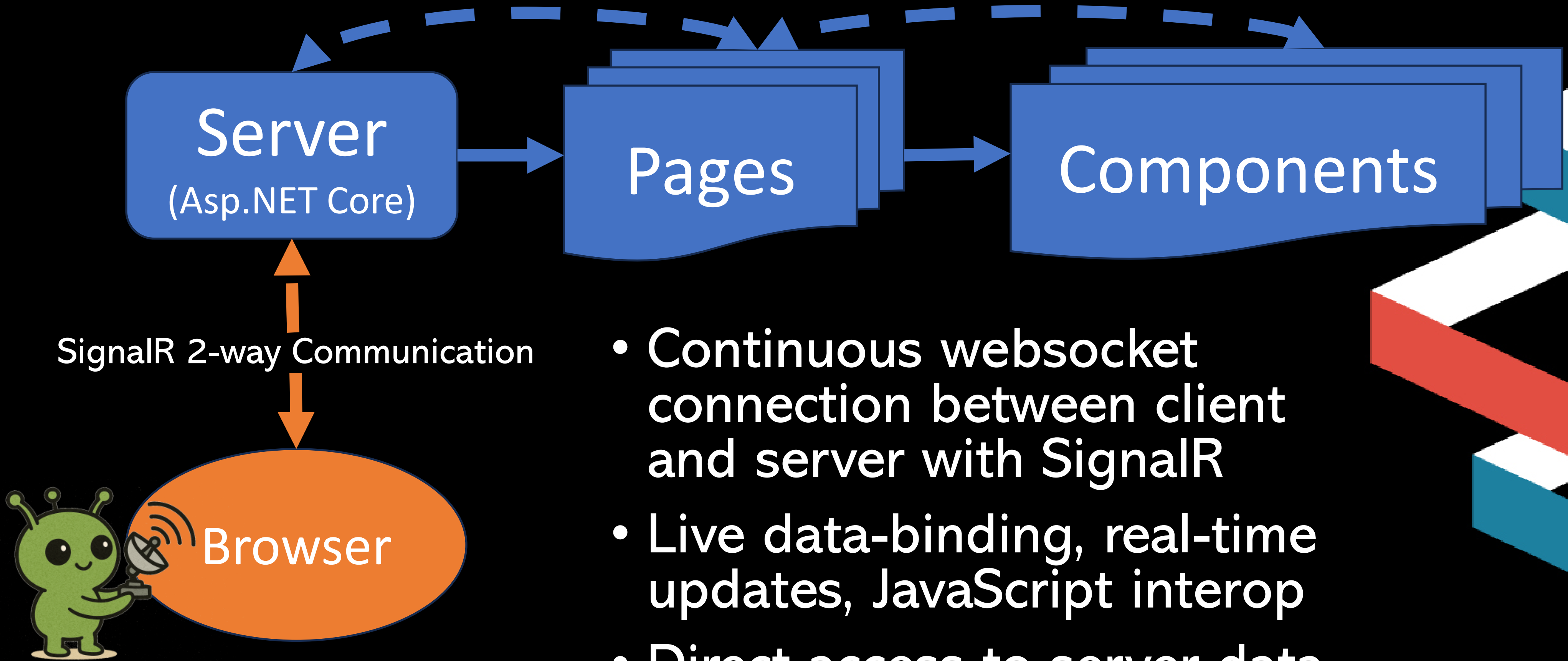
- “Traditional” server-side web, similar to ASP classic, WebForms, MVC, and Razor Pages
- Only static HTML, CSS, and JS files are sent to the client
- Supports a single-render and form post-backs
- No interactive updates via C# (can still use JS)

Blazor Render Modes: Static Server (cont.)



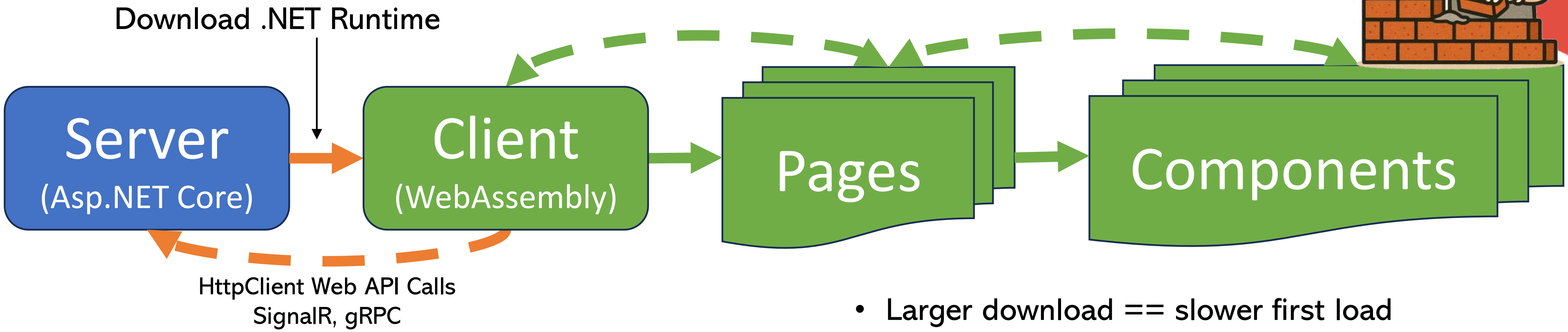
- Original Blazor lifecycle functionality is limited
- Does not call `OnAfterRender{Async}` method
- Bindings and C# event handlers with @ (e.g., `@onclick="() => counter++"`) will not update
- Good for blog posts, help pages, or other read-only content and simple forms

Blazor Render Modes: Interactive Server



- Continuous websocket connection between client and server with SignalR
- Live data-binding, real-time updates, JavaScript interop
- Direct access to server data store
- Fast on first load
- Can introduce network lag

Blazor Render Modes: Interactive WebAssembly



- Runs in the client browser
- Live data-binding, real-time updates, JavaScript interop
- HttpClient calls to communicate with server web API
- Single-threaded

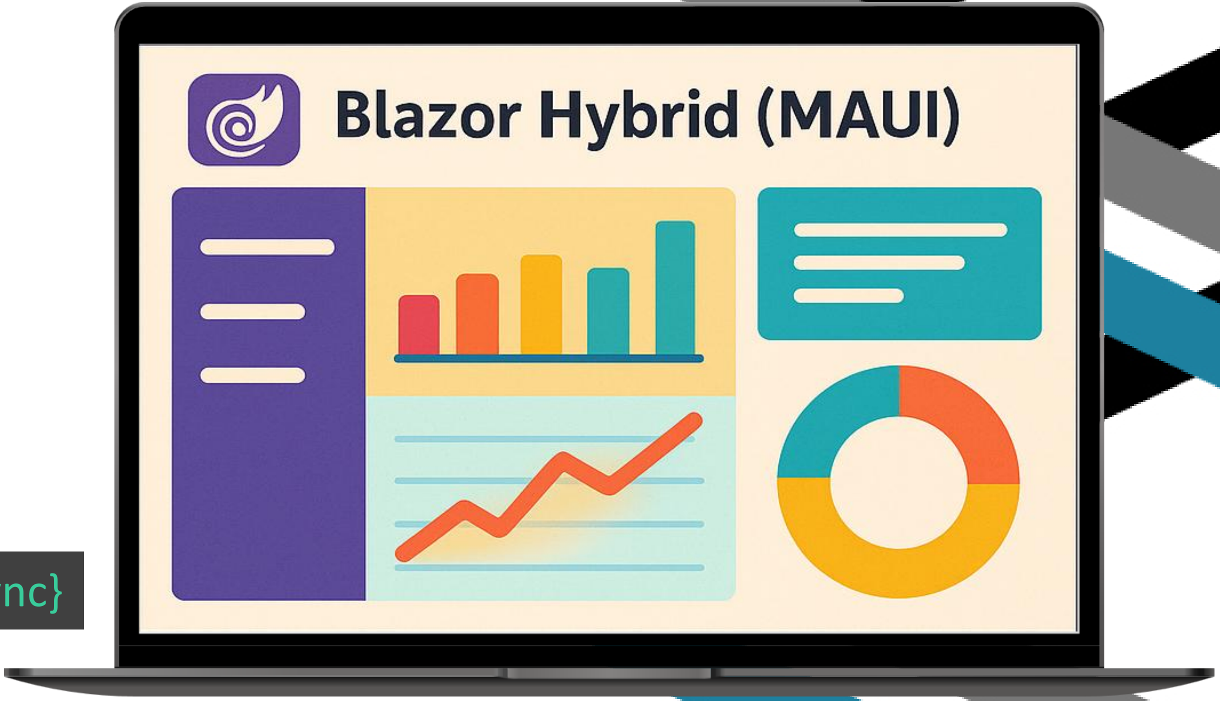
- Larger download == slower first load
- Faster interactions after first load (no network latency on events)
- Closest in approach to most JS SPA frameworks
- Available in the hosted Blazor Web App and standalone WebAssembly projects

Blazor Render Modes: Interactive Auto

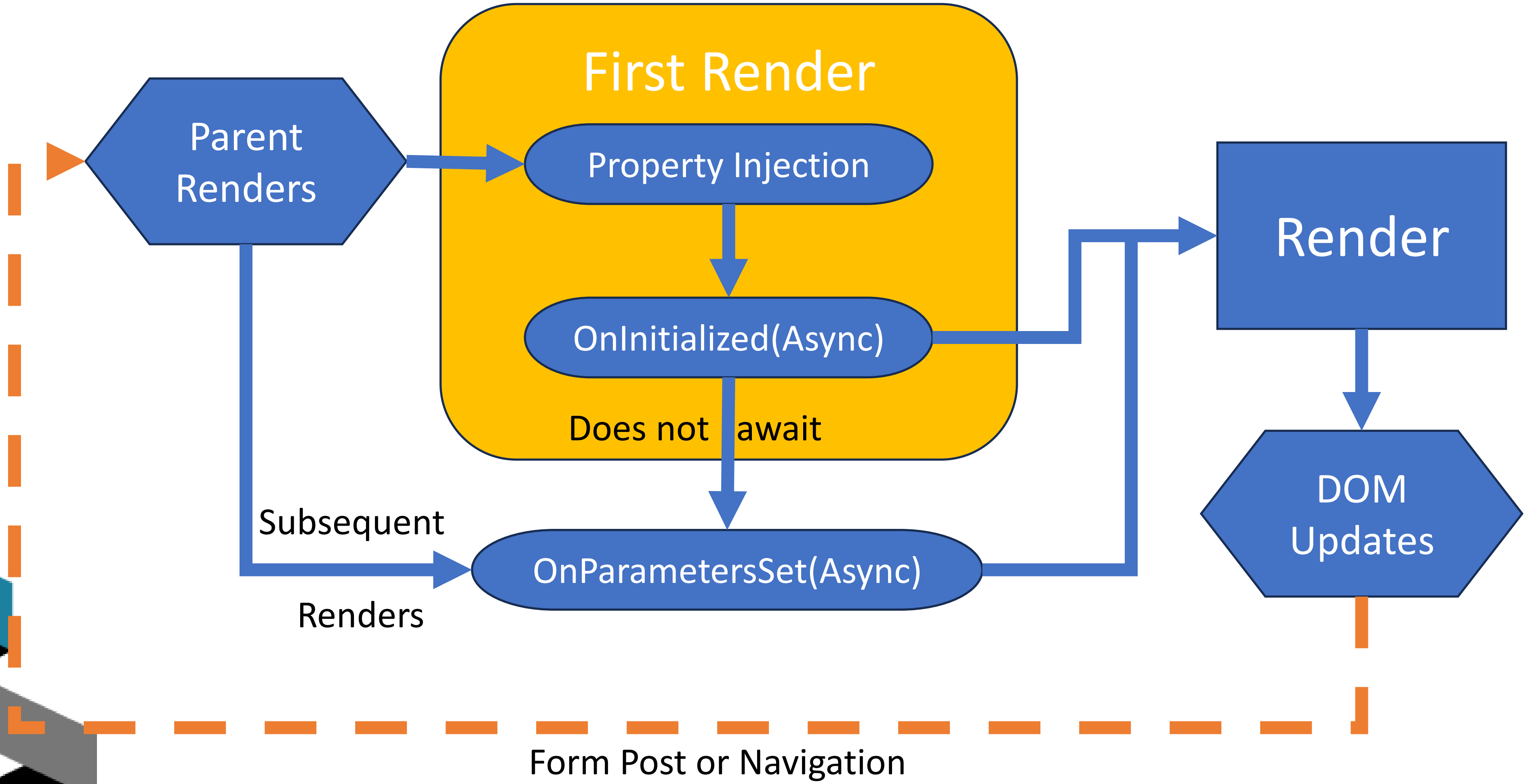
- On first load, runs from server, creating SignalR connection
- In the background, downloads .NET runtime and client code
- On next load, switches to running from WebAssembly
- “Best of both worlds”
  - Fast start on first load (server)
  - More responsive and robust interactions (client)
- Requires flexible data handling/abstraction to handle both client and server modes

Blazor Hybrid

- Runs in a WebView in .NET MAUI (iOS, Android, Mac, Windows), WPF, or Windows Forms
- Native .NET multi-threaded code execution (not WebAssembly)
- Access to device APIs (GPS, Bluetooth, photos, etc.)
- Can reuse components or entire UI applications between web, desktop, and mobile
- Always interactive, fires `OnAfterRender{Async}`
- Does not require defining `@rendermode`

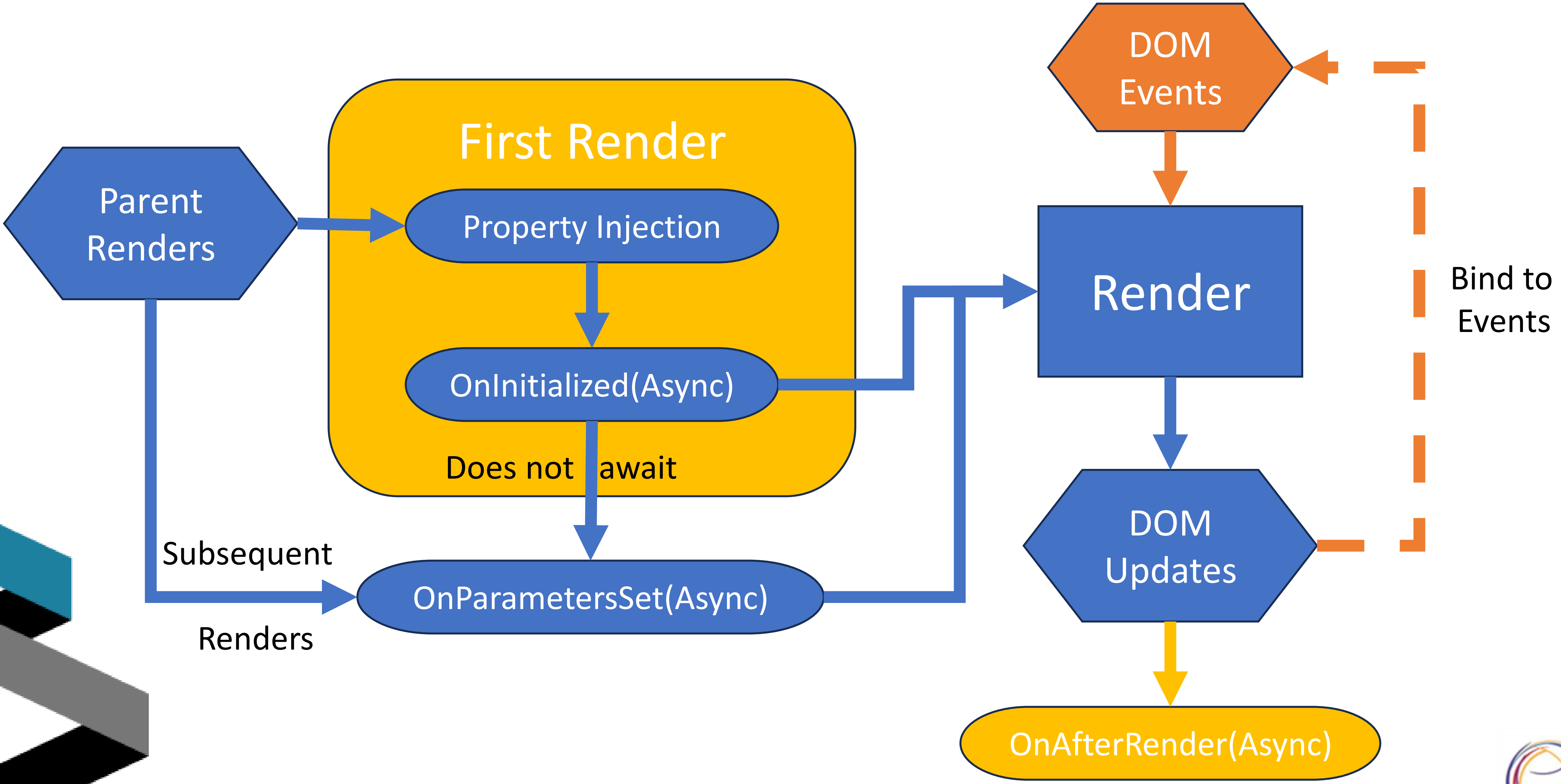


Razor Component Lifecycle: Static Server Mode



State set in OnInitialized and OnParametersSet should be Idempotent

Razor Component Lifecycle: Interactive Modes



Don’t set state that will cause a render cycle in OnAfterRender!

Architectural Patterns for State Management

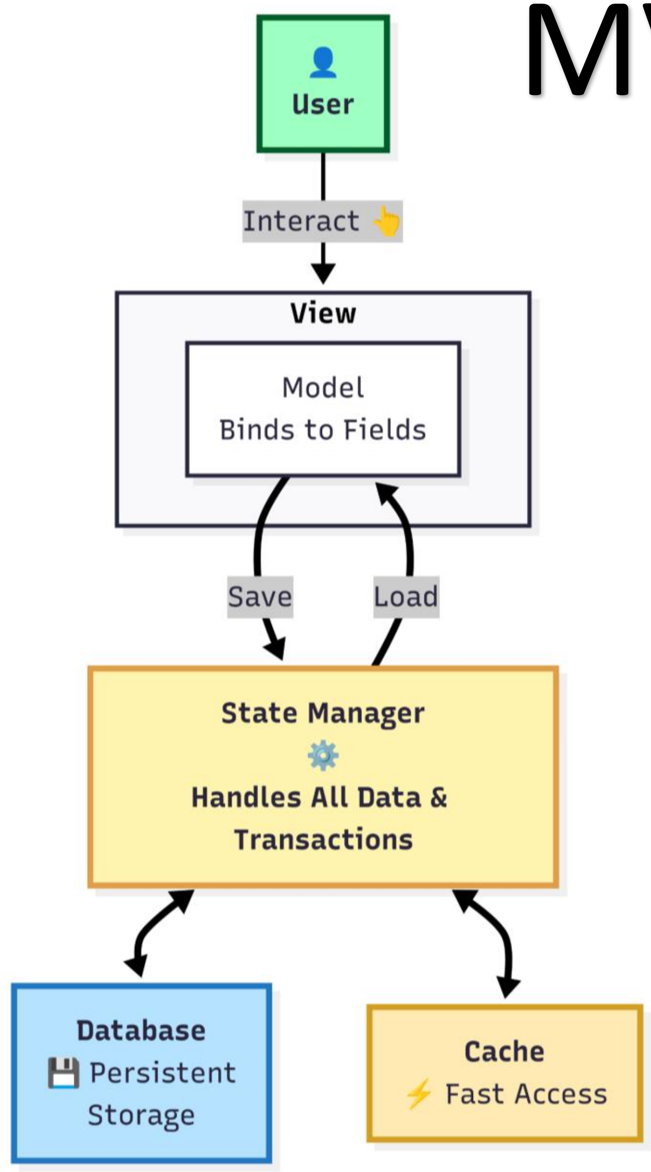
- **Some frameworks encourage you to manage state in a specific pattern**
  - **React – Flux/Redux/MVU**
  - **XAML Frameworks – MVVM**
  - **Asp.NET Core MVC – …MVC**
- **Blazor does not have a "default" named architectural pattern, but the decisions we make still impact how we manage the user and application state**

Architectural Patterns for State Management

- **Goals for Blazor State Management**
  - **Flexible components that will work in both Interactive Server and Interactive WebAssembly modes**
  - **Reduced boilerplate logic like pass-through methods**
    - ***(e.g., clientComponent => clientService => webApi => webService => dataRepository)***
  - **Consistent patterns for communication between components**
  - **Abstract away communication from WebAssembly client to Server**
  - **Keep pages and components lightweight and easy to read**
  - **Allow generic implementations for simple use cases**

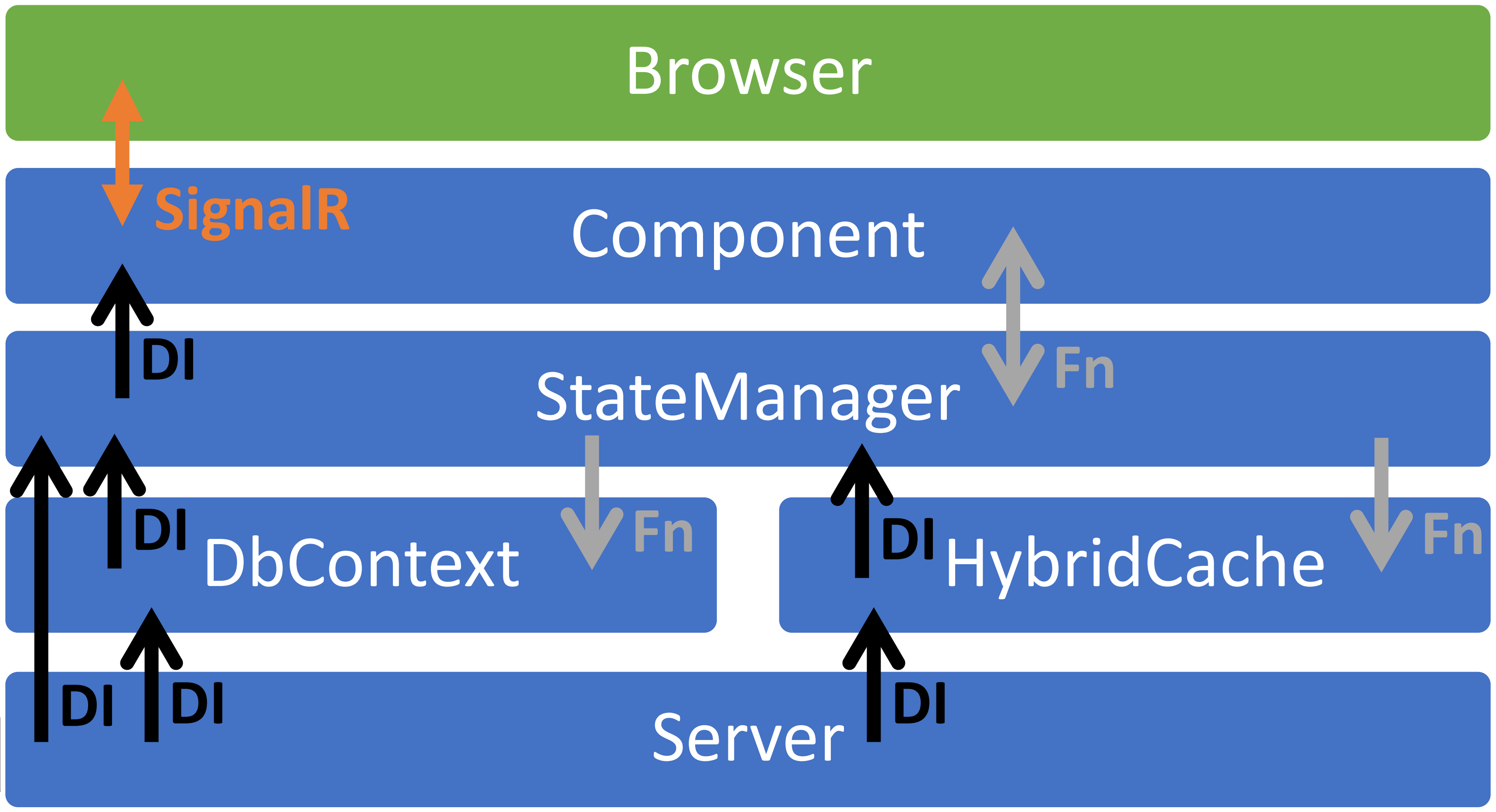
Architectural Patterns for State Management

MVSM™

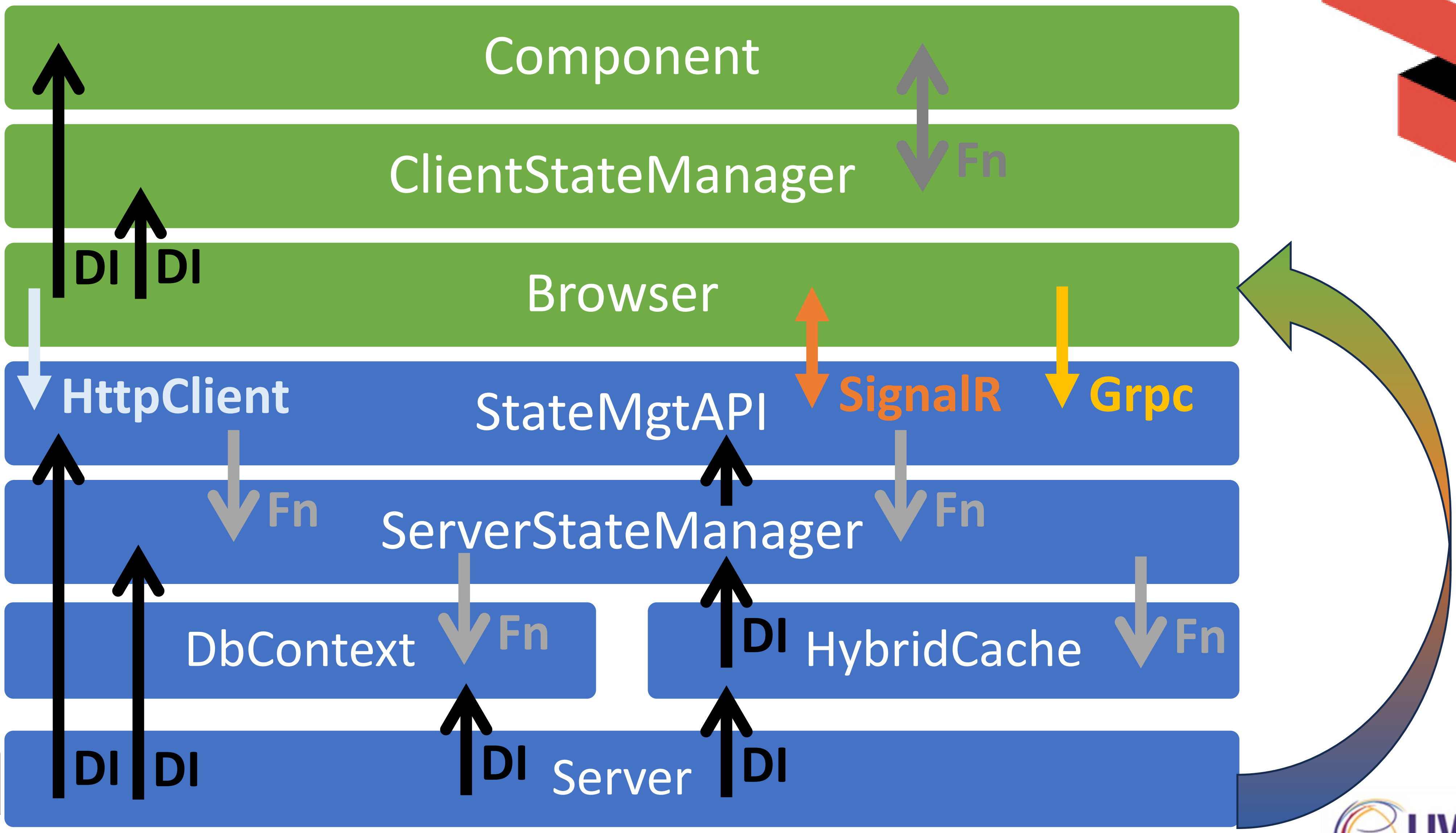


- **Model**
- **View**
- **State Manager**
- **Model and View designed to work together with two-way binding**
- **Model can live in either the View or the State Manager class**
- **State Manager is responsible for abstracting transport and any data transformation**

Server Component



Client Component



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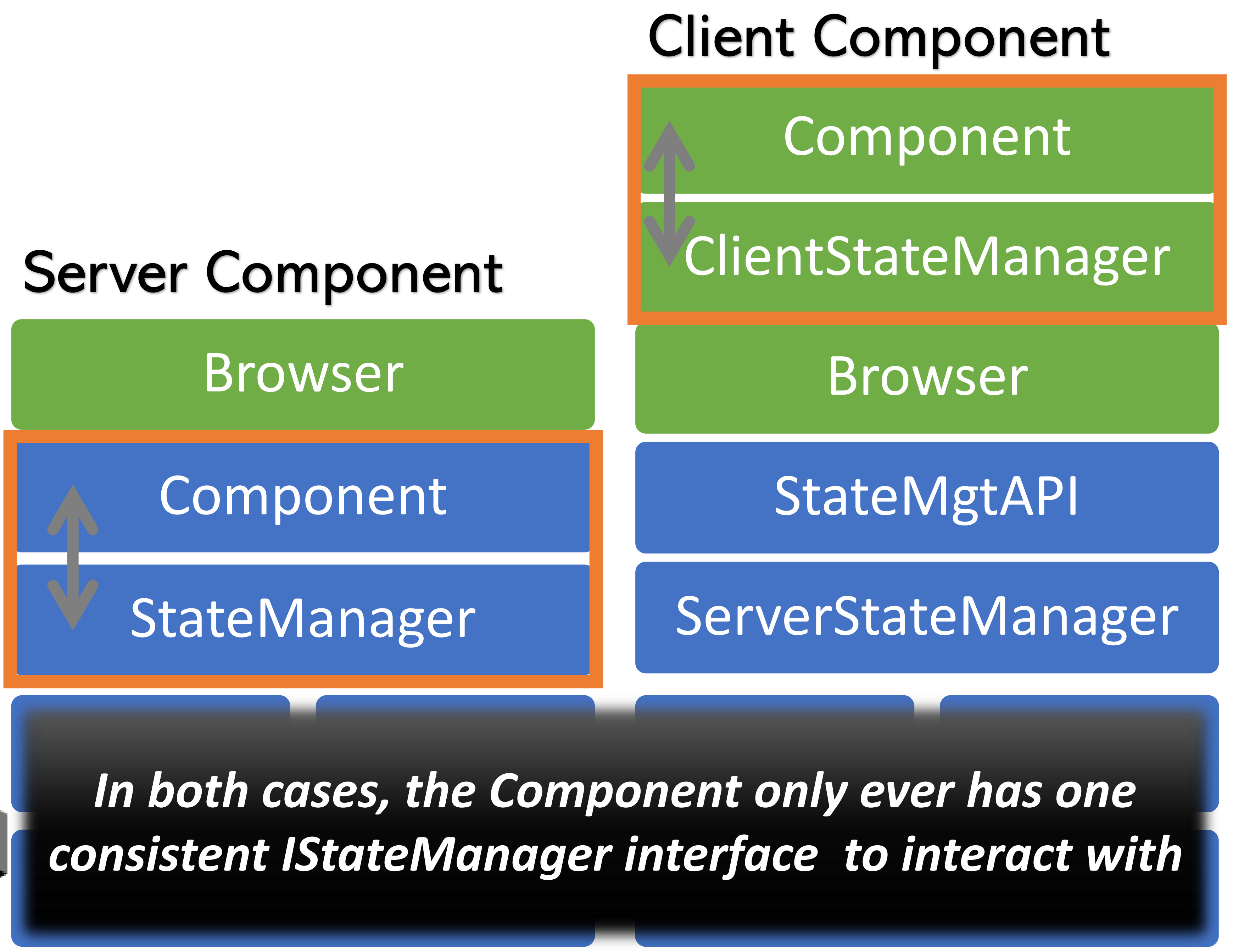


In both cases, the Component only ever has one consistent IStateManager interface to interact with

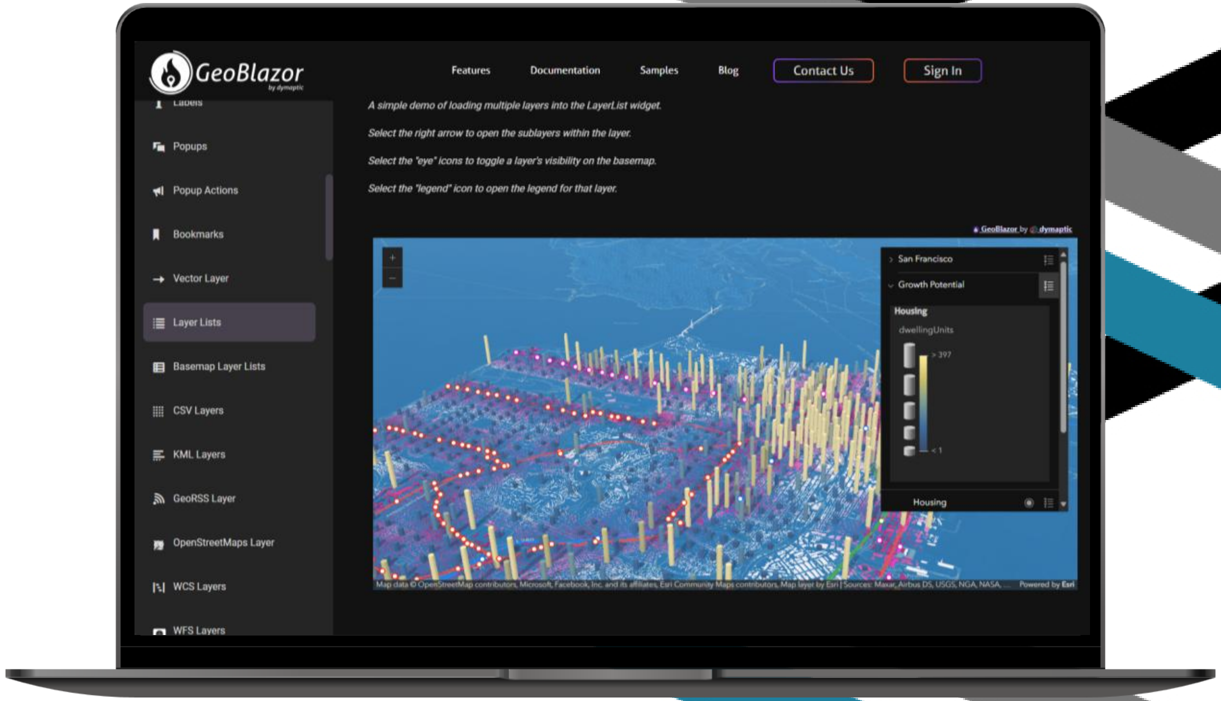
It Doesn’t Have to Be This Generic…

- This is just one idea of how to organize and abstract Blazor state across components and render modes
- You don’t *have* to use these generic interfaces/base classes. Sometimes that abstraction is overkill if you only have a handful of data types to deal with, or it just doesn’t fit if your data is manipulated in unique ways.
- Takeaways
  - Make a data service interface that can be injected into any component
  - Make a server implementation with straightforward db access
  - Make a client implementation with HttpClient and a Minimal Web API
  - You can re-use the server implementation as the service for the web API to access the db

Check out https://samples.geoblazor.com

- Fully interactive application samples written in C# and Razor
- Each page is written to run in both Client and Server mode (live sample is Client mode)
- GeoBlazor library utilizes JSRuntime to interact with the ArcGIS Maps SDK for JavaScript, so GeoBlazor *users* don't have to switch to JavaScript

GeoBlazor



A simple demo of loading multiple layers into the LayerList widget.

Select the right arrow to open the sublayers within the layer.

Select the "eye" icons to toggle a layer's visibility on the basemap.

Select the "legend" icon to open the legend for that layer.

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Thank You!

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