Modern Web Architectures

The Early Web

- Focus on finding and sharing static content
- Mainstream application architecture was client/server – not much thought was given to moving applications to the browser
- Early attempts at dynamic content were provided for limited use cases
- Some browsers supported “plugging in” applications into the browser

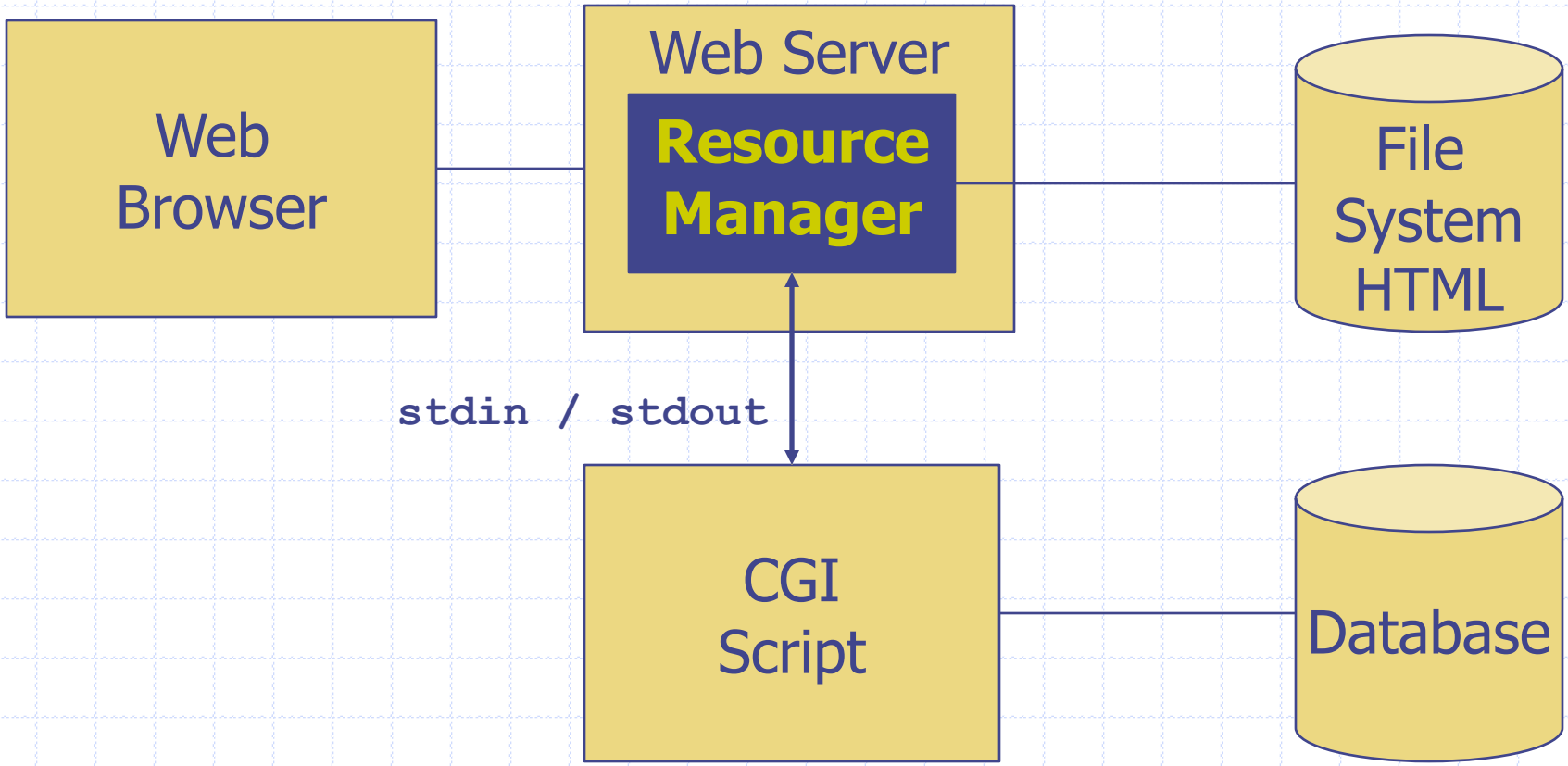
Web 1.0 Architecture

Web 1.0 Architecture

- Advantages
  - Simple
  - Cachable
  - Indexable
- Disadvantages
  - No dynamic content
  - No interaction with user – every request must go back to web server

Example : Netscape 1.0

Web 1.1 Architecture

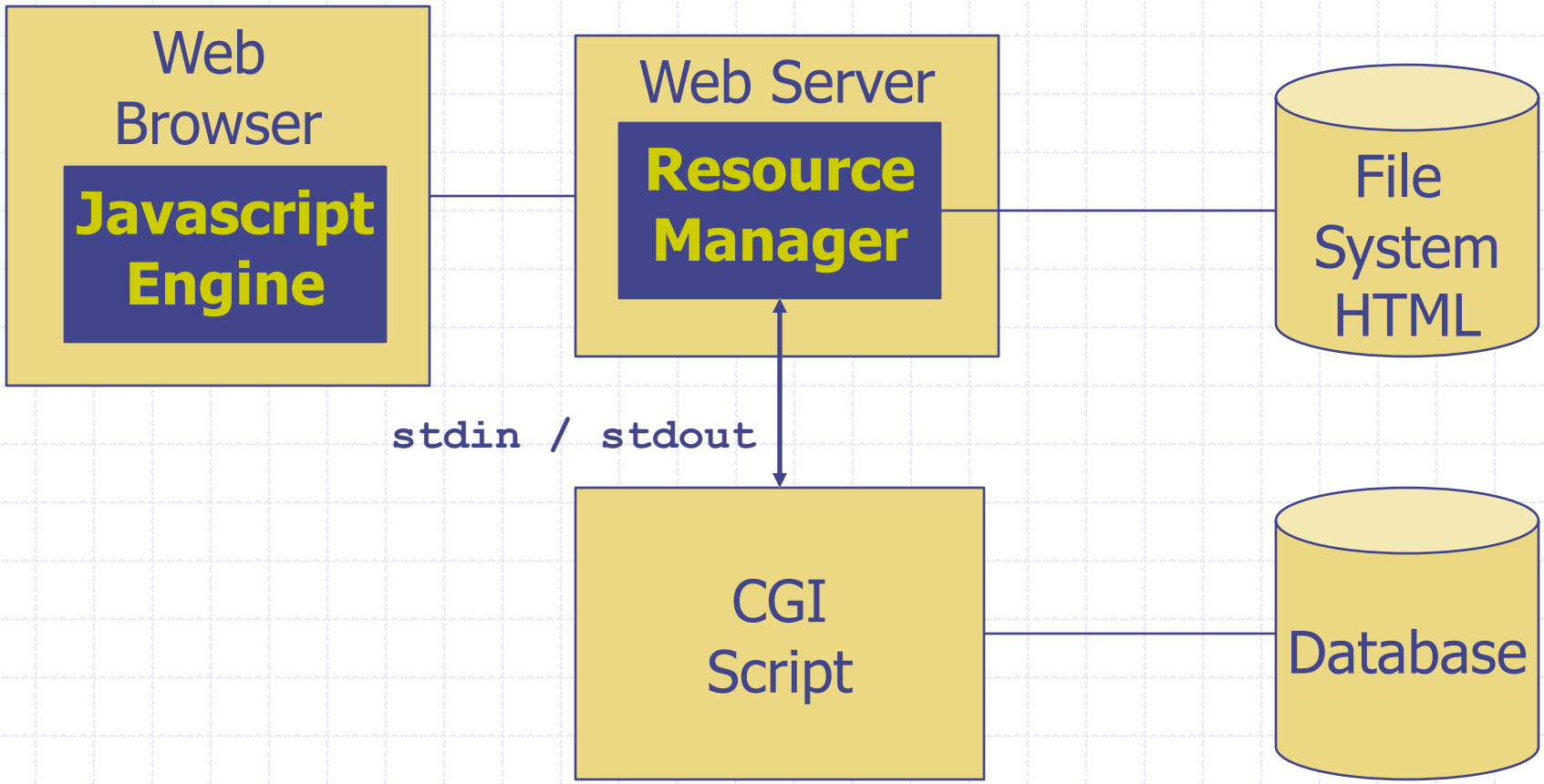


Web 1.1 Architecture

- Advantages
  - Somewhat Cachable
  - Some ability for Dynamic Content / Personalization
- Disadvantages
  - High compute overhead – need to run a separate process for each request
  - All I/O via anonymous pipes – must parse HTML in, and generate HTML out
  - Although introduces dynamic content, all updates require a round-trip to the server

Example : Perl

Web 1.2 Architecture

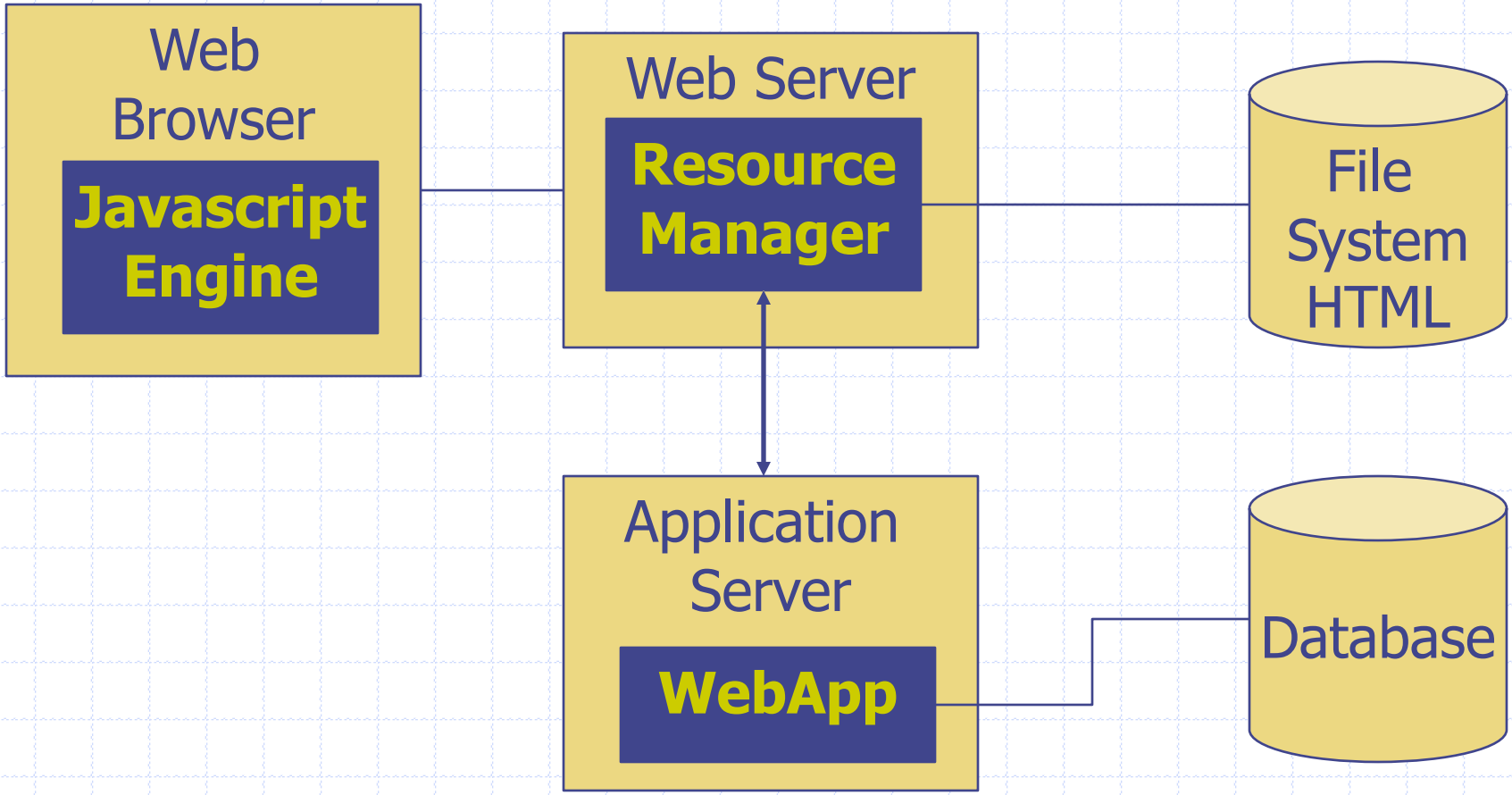


Web 1.2 Architecture

- Advantages
  - Improved user experience – user input can be validated client side
  - Some dynamic DOM manipulation to avoid round-trips to the server
- Disadvantages
  - Same issues as architecture 1.1
  - Code redundancy – same code needed on client and server side
  - Javascript engines not very compatible

Example : Netscape, IE3

Web 1.5 Architecture

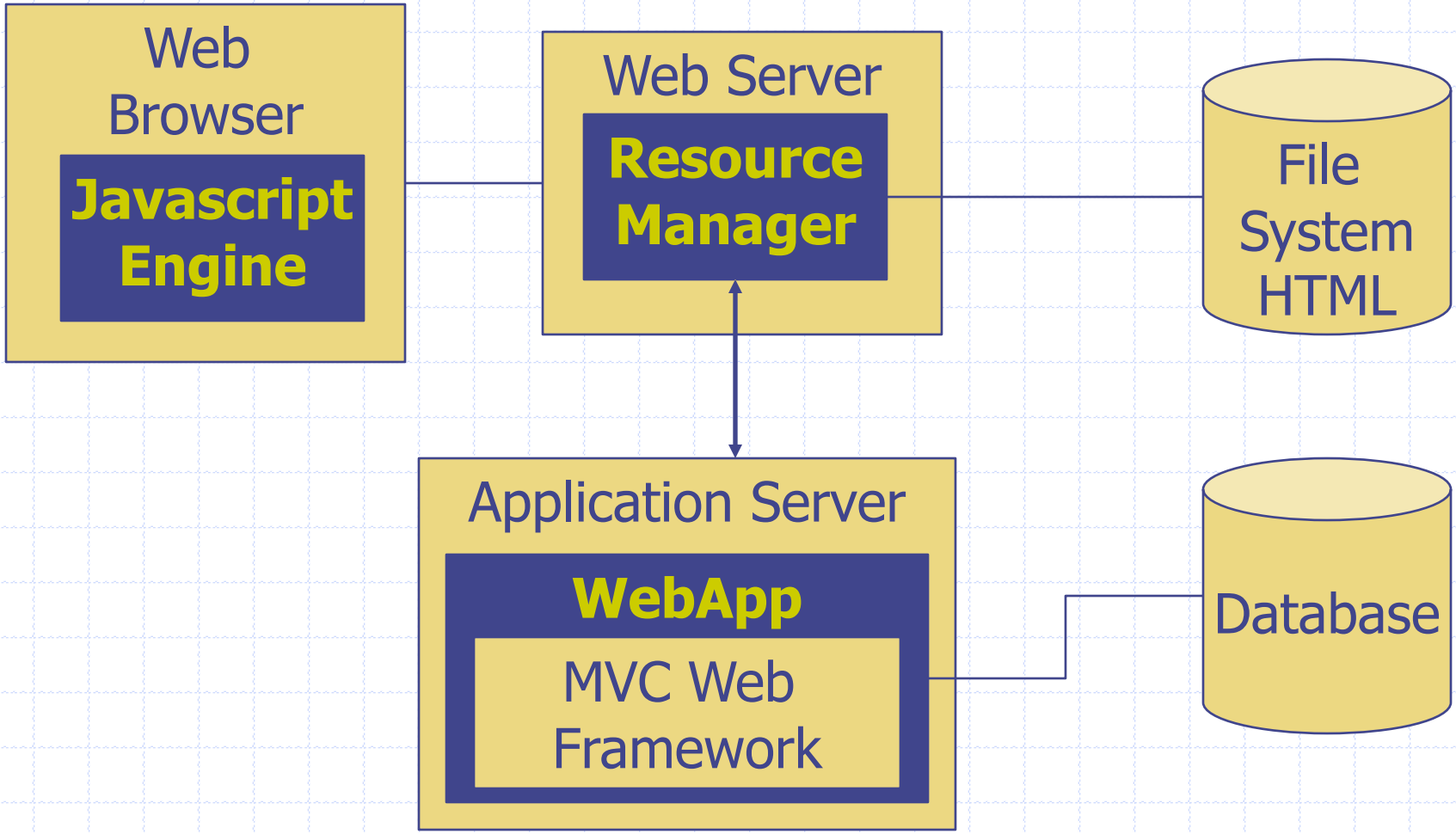


Web 1.5 Architecture

- Advantages
  - Introduction of an application server component to provide lifecycle management for web applications
  - Move to per-threads versus per-process for requests
  - Wrappers for request and response objects, simplifying the need to parse and generate HTML
- Disadvantages
  - Still need to work on a HTTP request an HTTP response level
  - Common to generate

Example : Tomcat 1.0

Web 1.5+ Architecture



Web 1.5+ Architecture

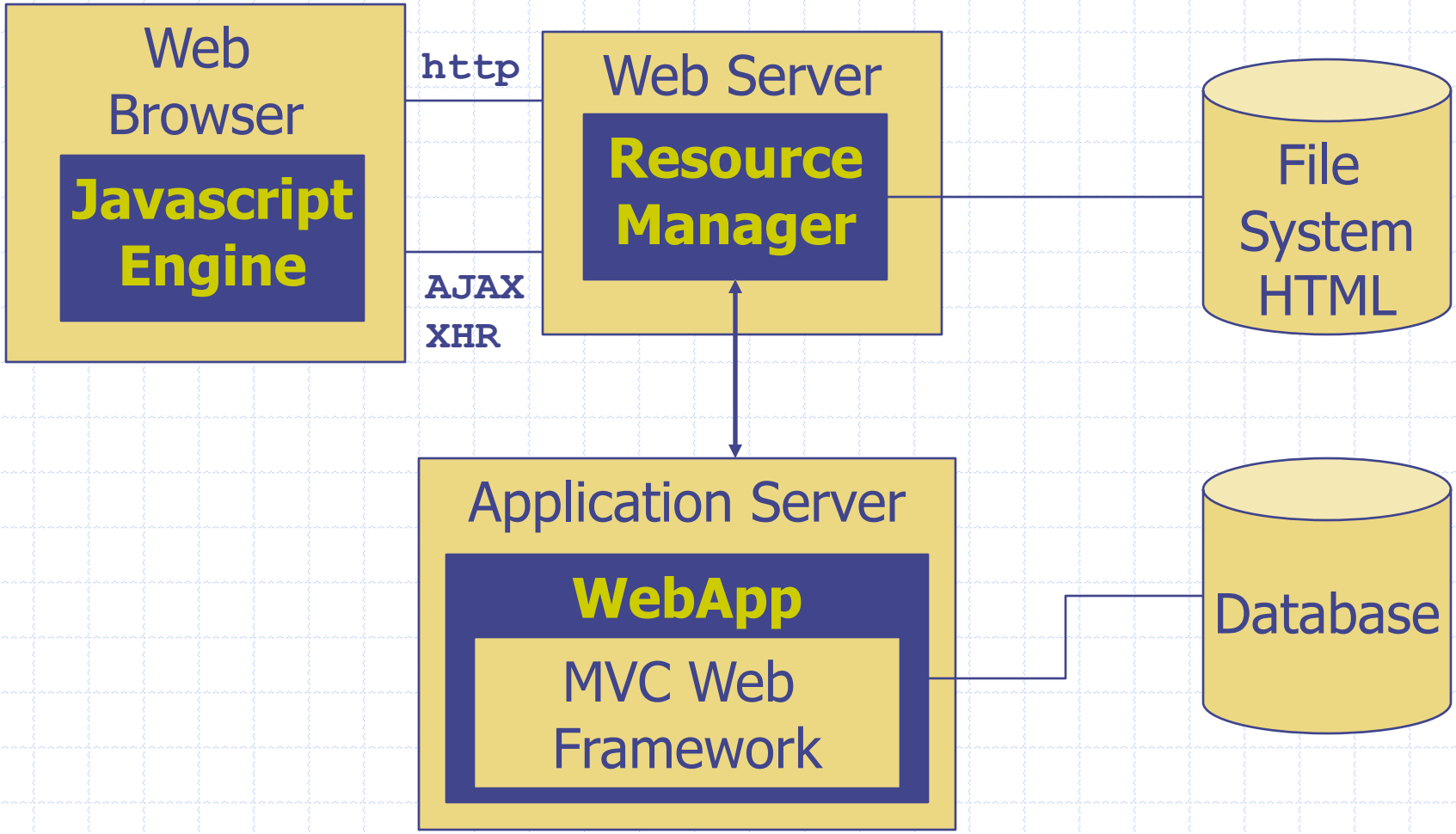
- Advantages
  - Introduces the MVC framework to modularize server code
  - Views can be pre-compiled to improve speed
  - Views can be created in markup instead of code
- Disadvantages
  - Same as web 1.5
  - Introduces additional complexity due to the discipline needed to work with, and configure a MVC framework
  - Introduces non-standard markup to bind the view and controller

Example : Spring MVC, Struts, ASP.Net

The Web 2.0 Architecture

- Demand for robust user experience delivered to the browser starts to emerge
- Javascript becomes a platform by accident – drives explosion of Javascript frameworks.
- XmlHttpRequest (XHR), which found its way into early browsers for limited use cases, is exploited by Google to create some amazing applications

Web 2.0 Architecture

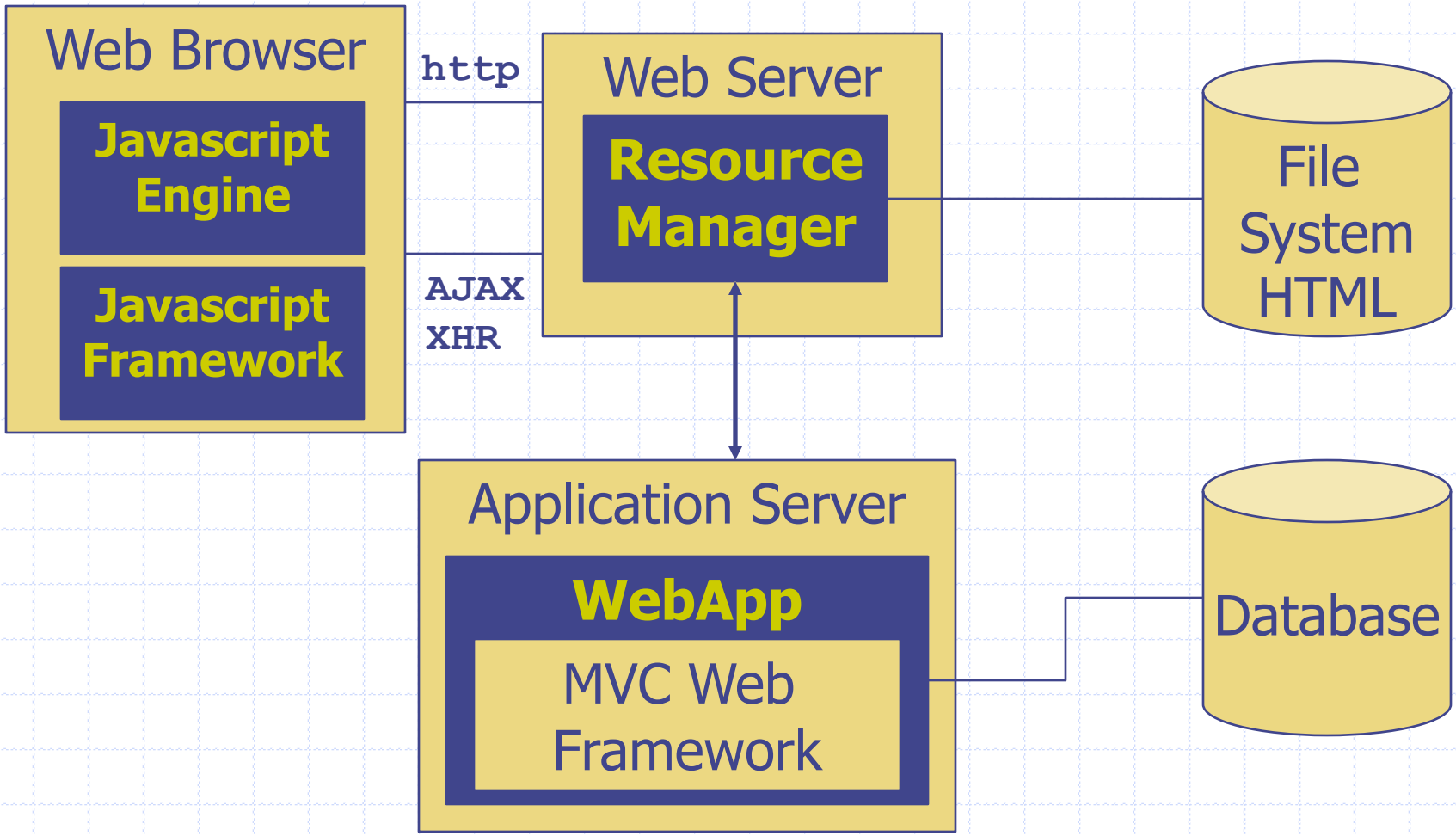


Web 2.0 Architecture

- Advantages
  - First time ever having desktop like experience on browser-based application – amazing experience
  - Can alter the UI without having to refresh the entire page
- Disadvantages
  - Significant programming complexity
  - Significant testing required due to browser differences in handling Ajax/XHTR
  - Server-side resources must be returned from the same domain as the place that loaded the code (no cross-domain is allowed)
  - Javascript libraries are required to deal with complexity - jQuery

Example : Google Maps

Web 2.0+ Architecture



Web 2.0+ Architecture

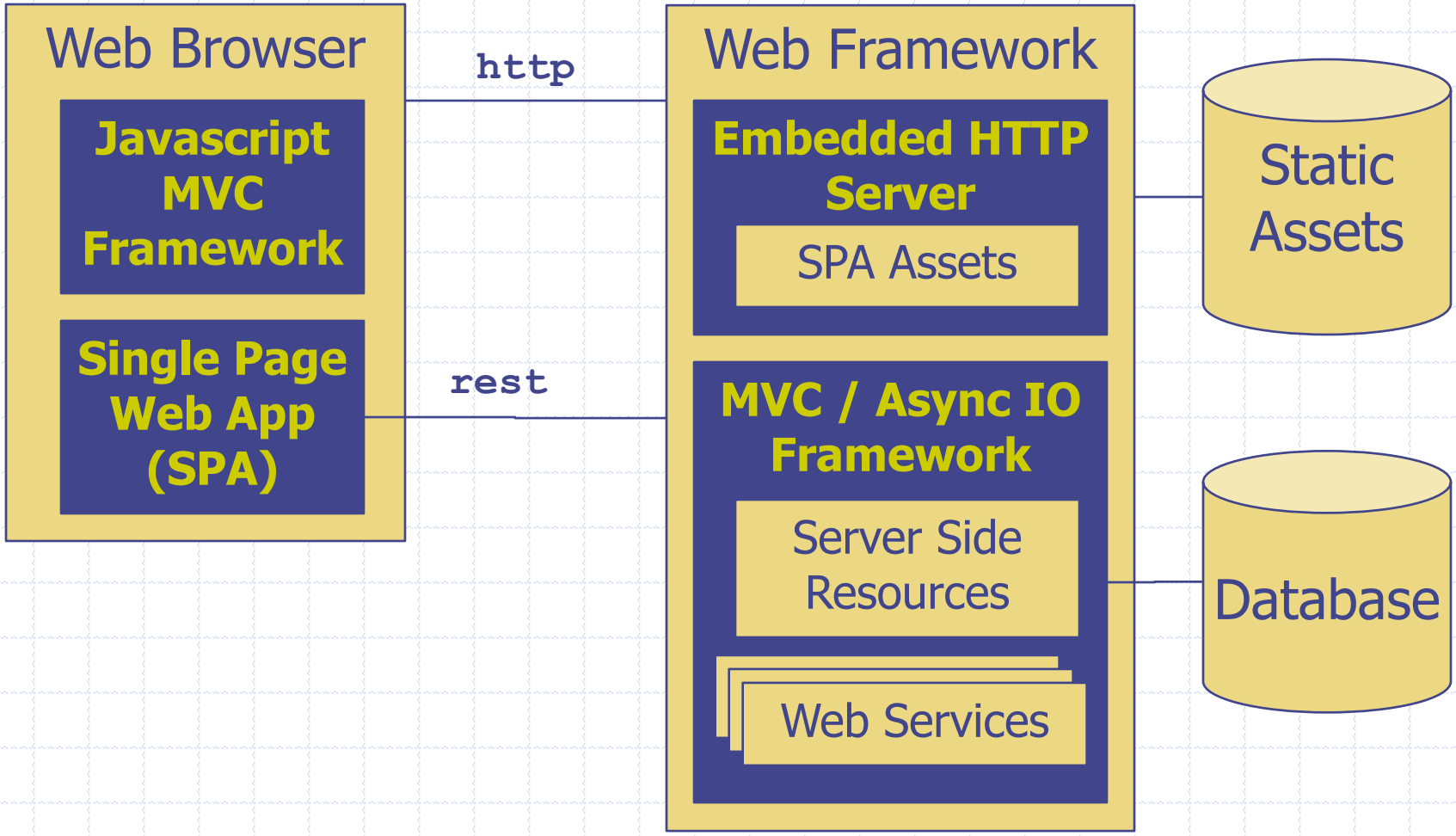
- Advantages
  - Robust frameworks are developed to address Javascript complexity and Javascript compatibility
  - Application functionality and richness continues to grow
- Disadvantages
  - Javascript codebases explode in size, programming model is based on pattern-matching and callbacks gets difficult to support
  - New frameworks come and go almost on a weekly basis making it difficult to gain stability in the web 2.0 space

Example : Gmail, mustache, handlebars, underscore

The Web 3.0 Architecture

- Application moves to the browser
  - Leverages frameworks typically found on the server to simplify Javascript
  - Enables application to be delivered from a CDN
  - Allows for the application to run disconnected using local storage
- Server primarily used to deliver data to the client
- Server used to protect secrets such as API keys and manage security given that the code on the client can be viewed from any browser

Web 3.0 (rev 1) Architecture

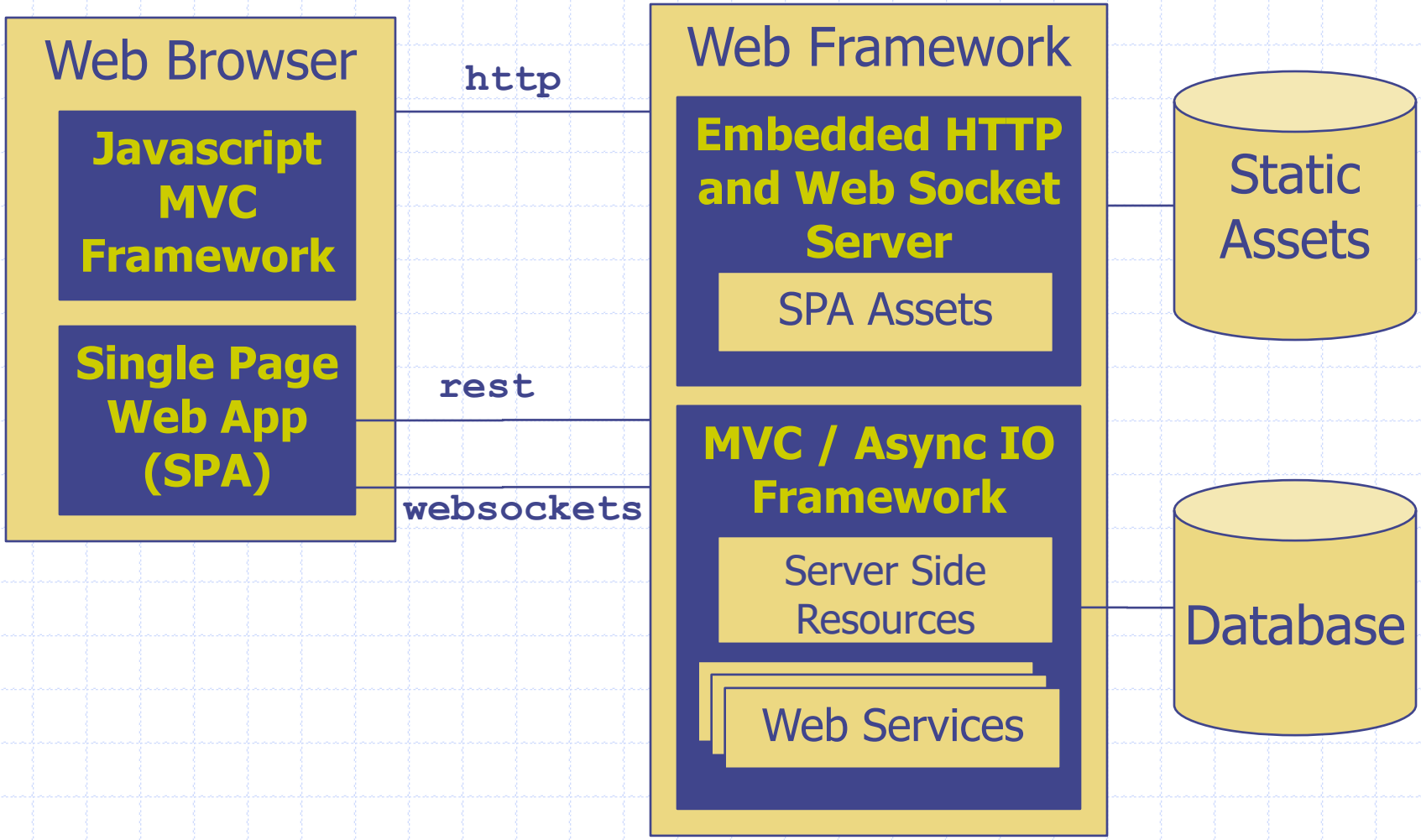


Web 3.0 (rev 1) Architecture

- Advantages
  - Extremely robust applications are possible
  - Frameworks finally enable Javascript as a platform– modularization, scope management, dependency injection, promise/futures, etc
  - Frameworks enable full lifecycle debugging, and robust build/configuration management
  - Cacheable and CDN friendly – only data needs to flow back to browser app
  - Enables "reactive" programming model and async-IO to improve scalability
- Disadvantages
  - Still need to master Javascript
  - Polyglot (is advantage and disadvantage)
  - Security might be challening – cant maintain secrets in client app (e.g., "View Code")
  - Traditional application servers still request/reply based, limits scalability in some cases

Example : AngularJS, BackboneJS, Node.js

Web 3.0 (rev 2) Architecture

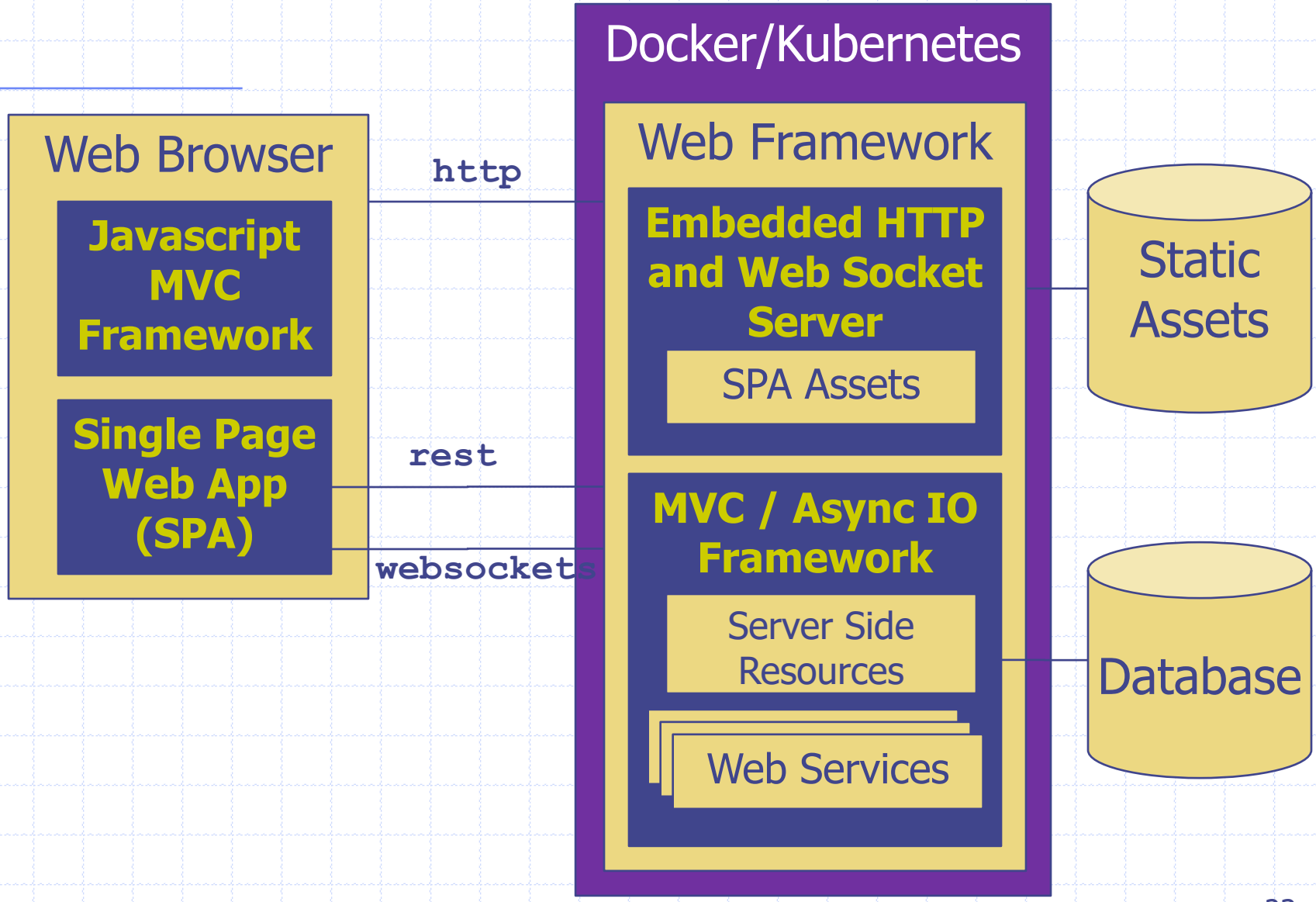


Web 3.0 (rev 2) Architecture

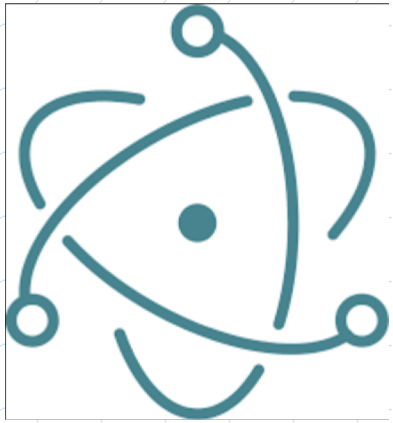
- Advantages
  - Able to support for the first time real time architectures for applications like trading, chat, gaming etc
  - Eliminate overhead of using the HTTP protocol
  - Messages can be initiated from either the client (browser) or server
- Disadvantages
  - Only modern browsers support, although web sockets can be simulated with XHR long polling
  - Some proxies and HTTP infrastructure don't know how to deal with web sockets (this will change)

Example : SockJS, socket.io, Node.js, Play!

Web 3.0 (rev 3) Architecture



So Why Are Modern Web Architectures Useful

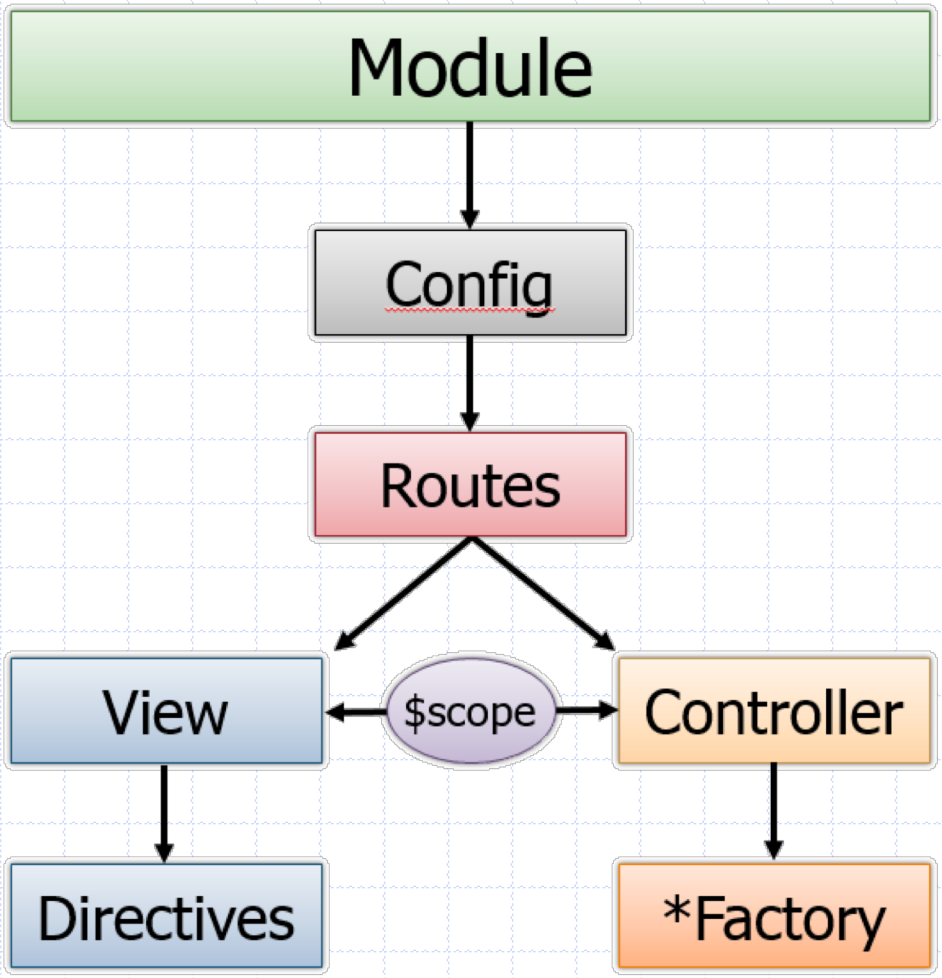


Desktop Apps via Electron

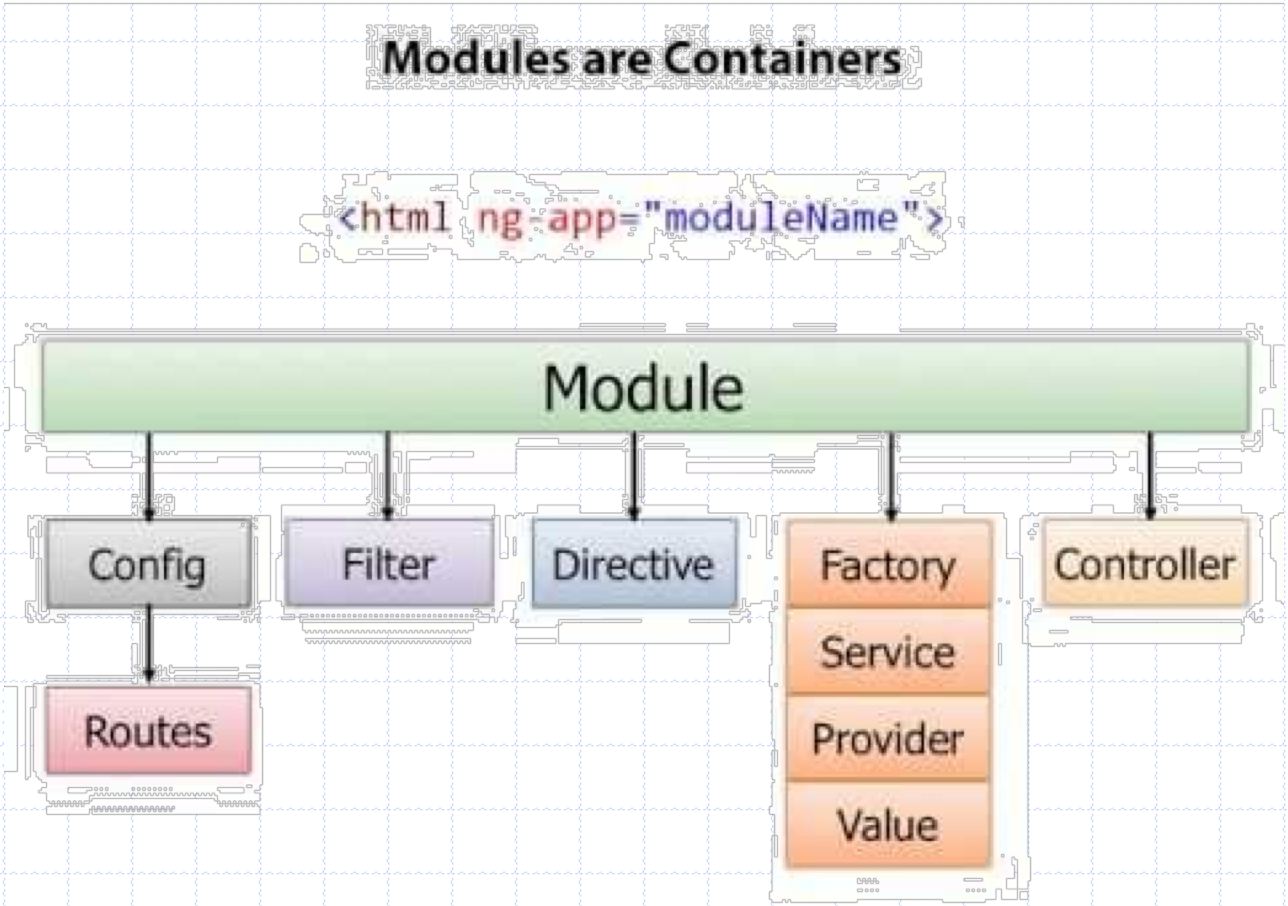
Engaging Web Apps

Native Mobile Apps

Modern Web Architectures: Front End MVC - AngularJS Example



Example: AngularJS Architecture



Example: Lets Look at Angular via Example

We will look at some examples from here:

https://curran.github.io/screencasts/introToAngular/exampleViewer/#/

Angular 1.x

The good and the bad discussion, what do you think?

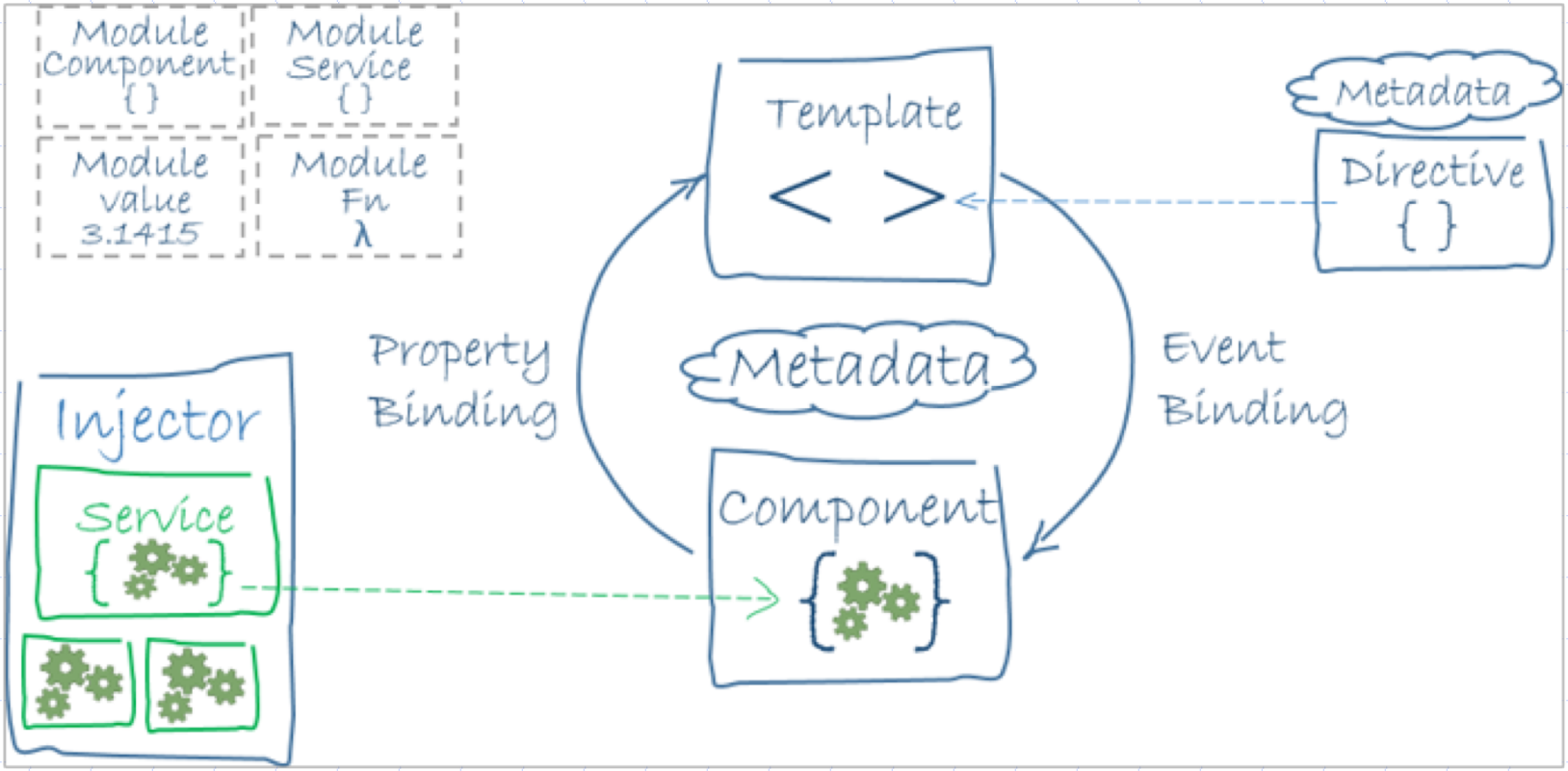
Javascript vs Typescript

JavaScript has grown up a good bit, but we will actually be using TypeScript instead because it has many advantages

Lets take a look at the Typescript Playground: https://www.typescriptlang.org/

Angular.io (Angular 7 currently)

SEE: https://angular.io/guide/architecture



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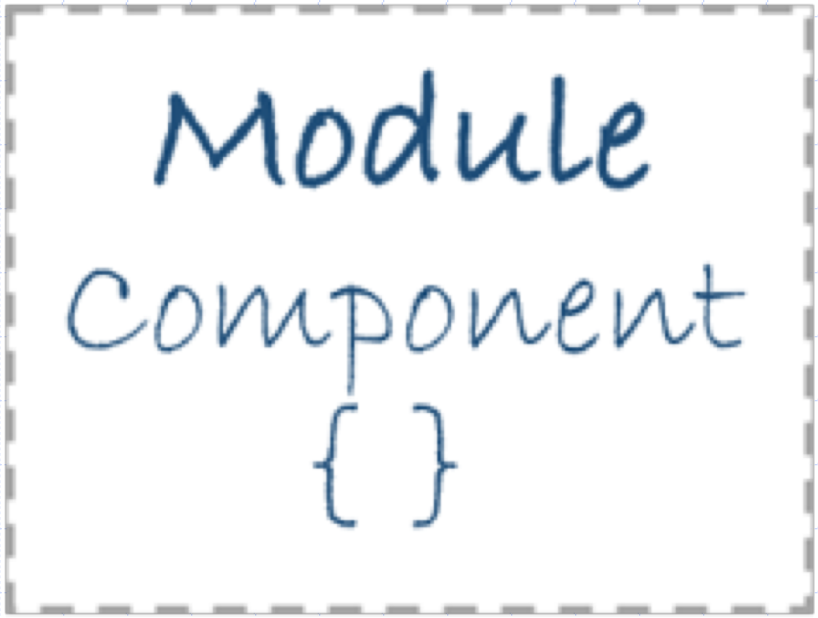

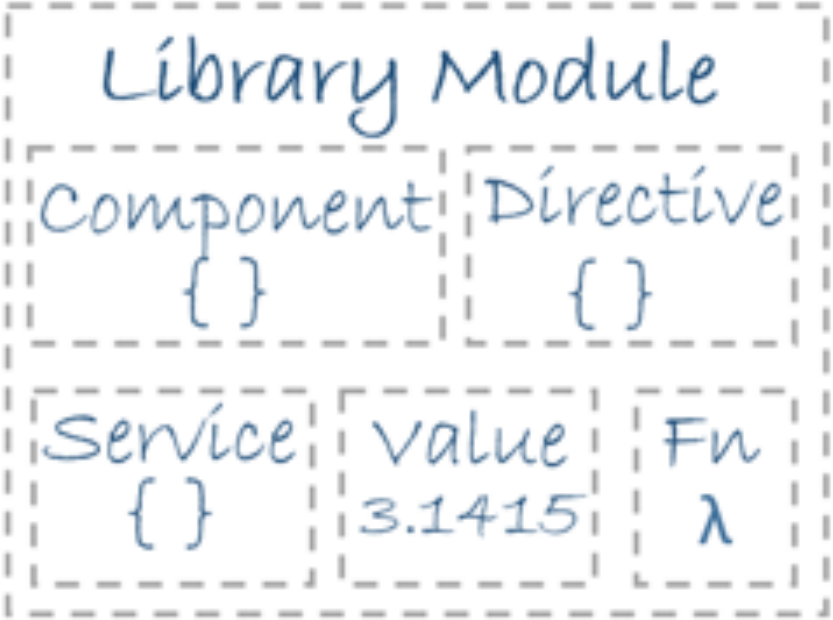

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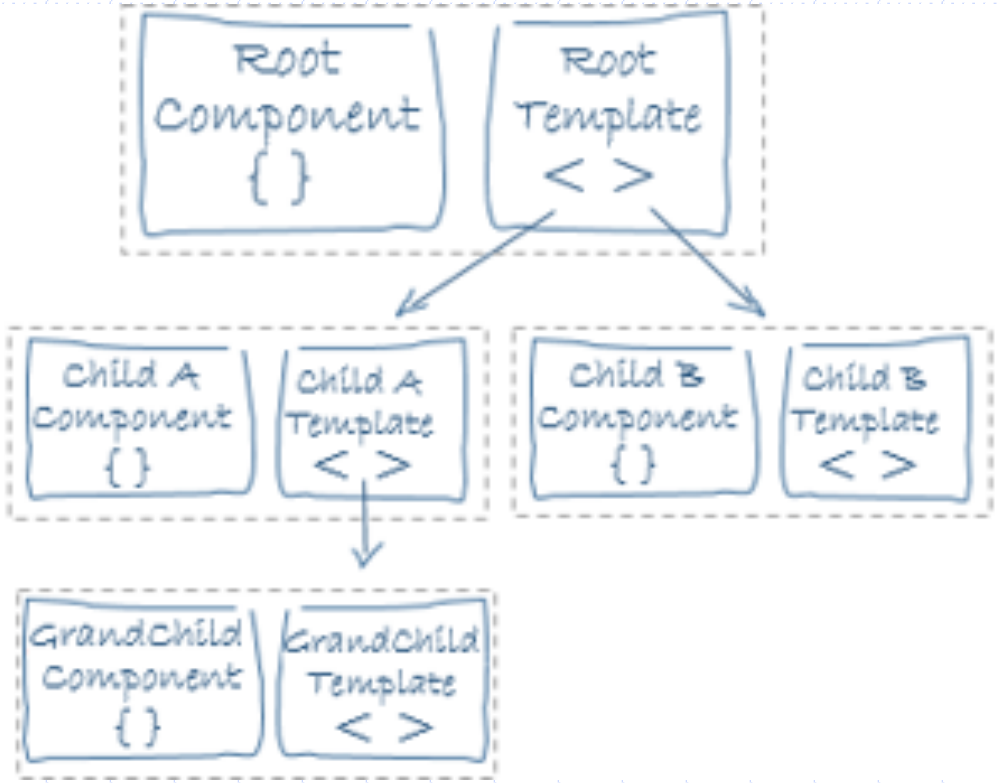

Angular.io

SEE: https://angular.io/guide/architecture

src/app/hero-list.component.ts (metadata)

```
@Component({
  selector:    'hero-list',
  templateUrl: './hero-list.component.html',
  providers:  [ HeroService ]
})
export class HeroListComponent implements OnInit {
/* . . . */
}
```

Angular.io

SEE: https://angular.io/guide/architecture

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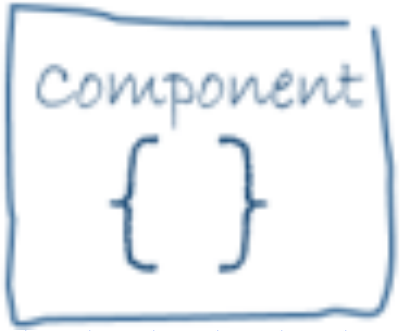

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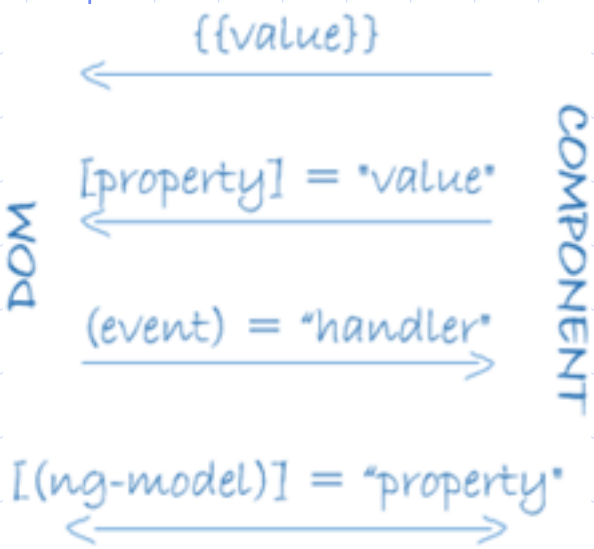
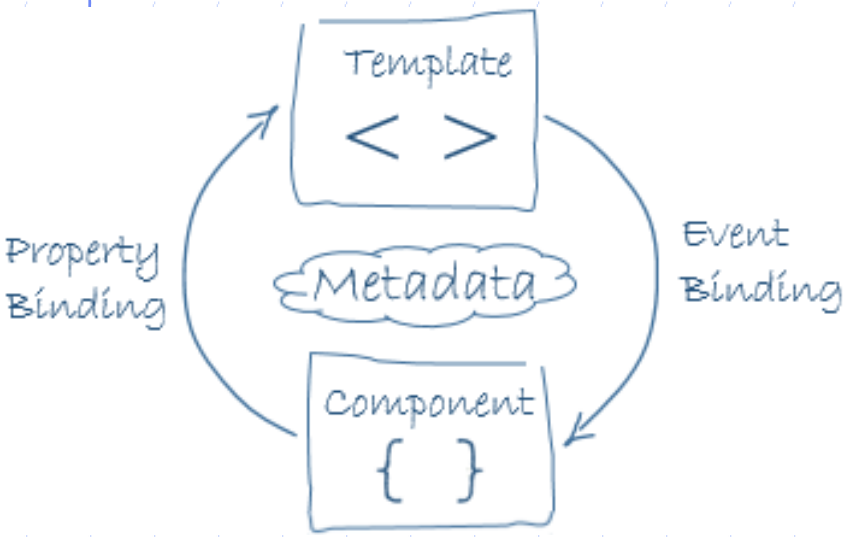


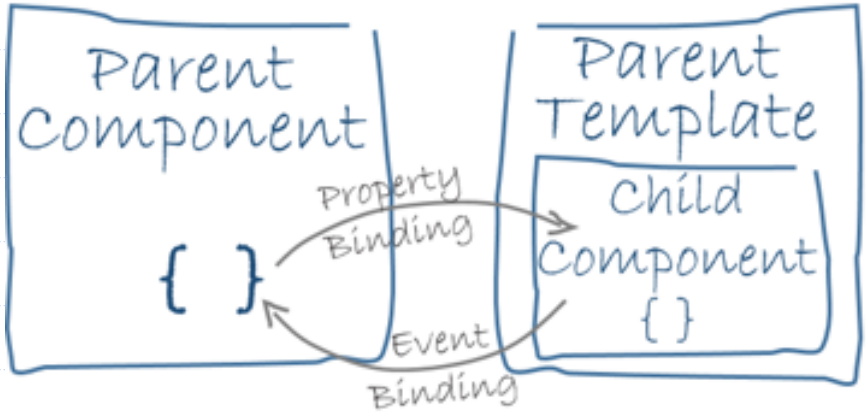
src/app/hero-list.component.html (binding)

```
<li>{{hero.name}}</li>
<hero-detail [hero]="selectedHero"></hero-detail>
<li (click)="selectHero(hero)"></li>
```

Angular.io

SEE: https://angular.io/guide/architecture





Angular.io

SEE: https://angular.io/guide/architecture

src/app/hero-list.component.html (structural)

```
<li *ngFor="let hero of heroes"></li>
<hero-detail *ngIf="selectedHero"></hero-detail>
```

Angular.io

SEE: https://angular.io/guide/architecture

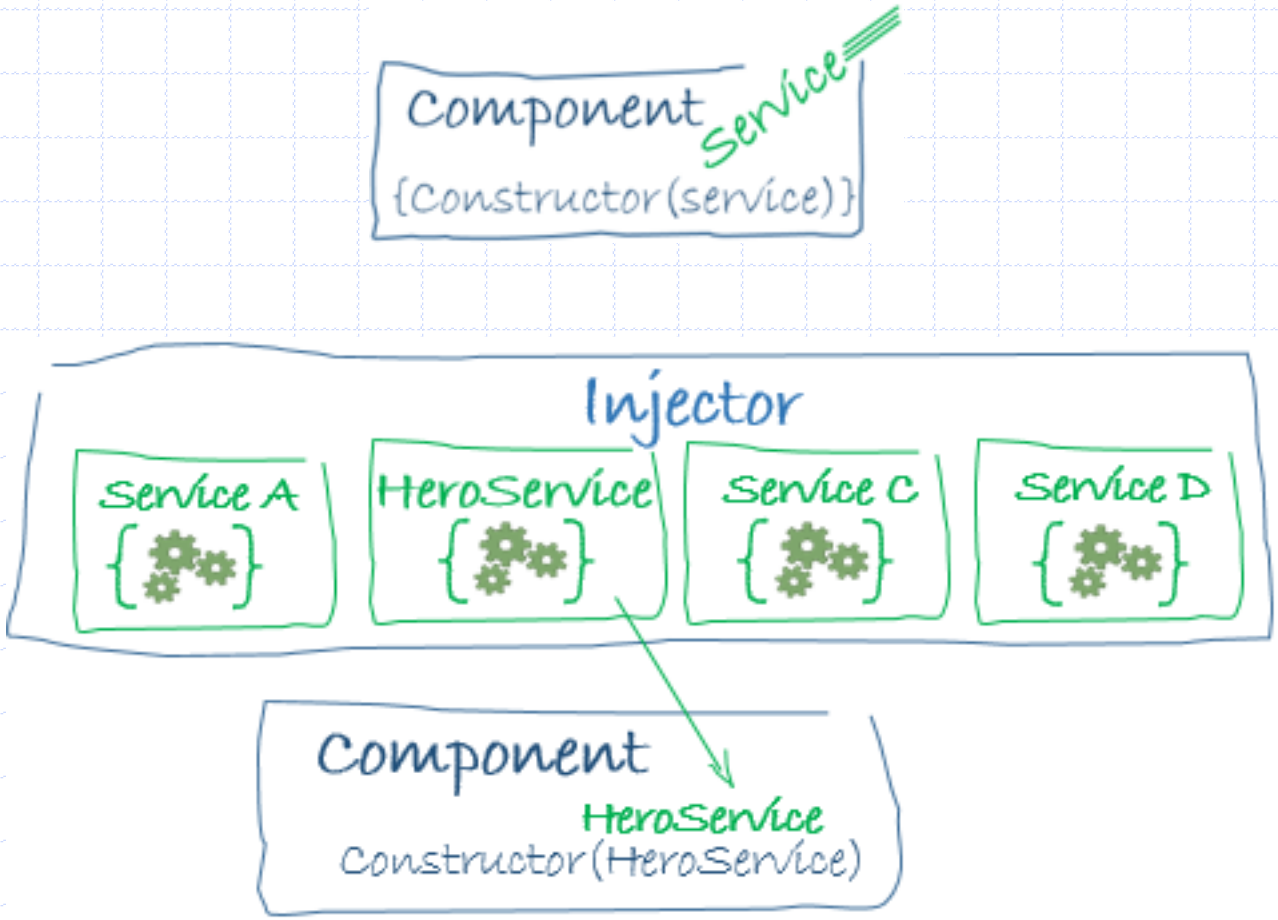
src/app/logger.service.ts (class)

```
export class Logger {
  log(msg: any)   { console.log(msg); }
  error(msg: any) { console.error(msg); }
  warn(msg: any)  { console.warn(msg); }
}
```

A service is just a class, recommend decorating with @Injectable()

Angular.io

SEE: https://angular.io/guide/architecture



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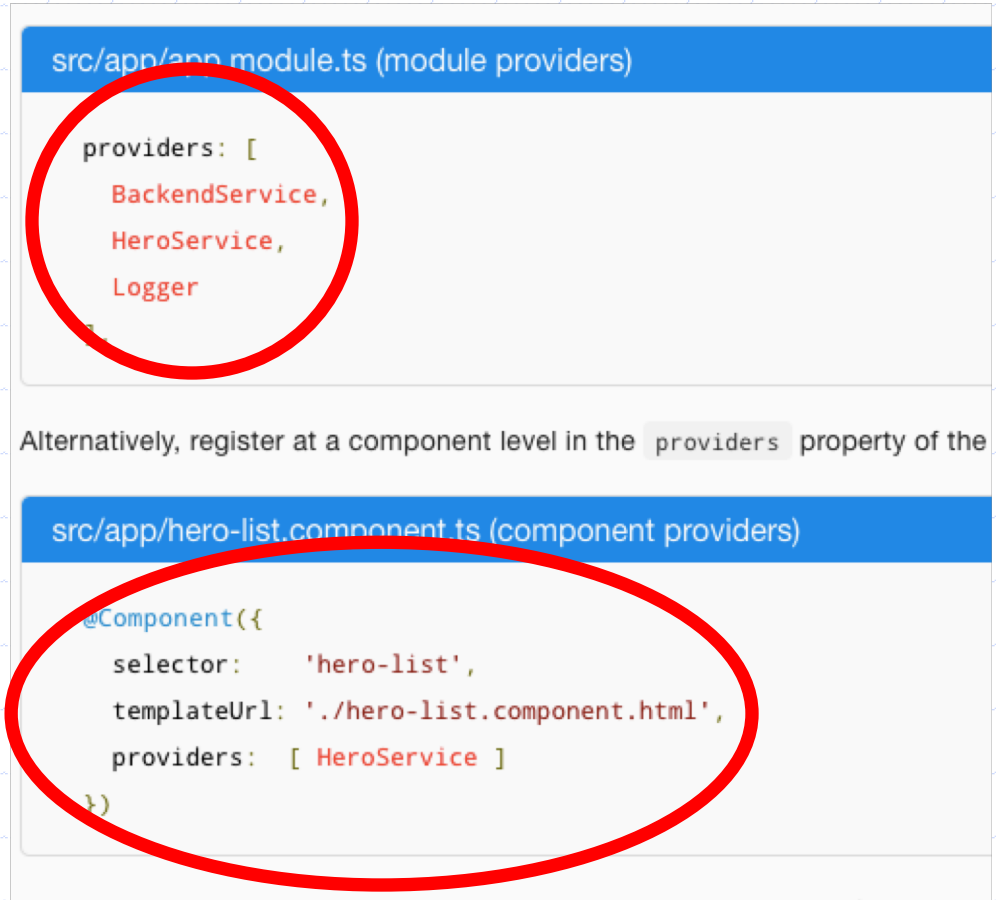
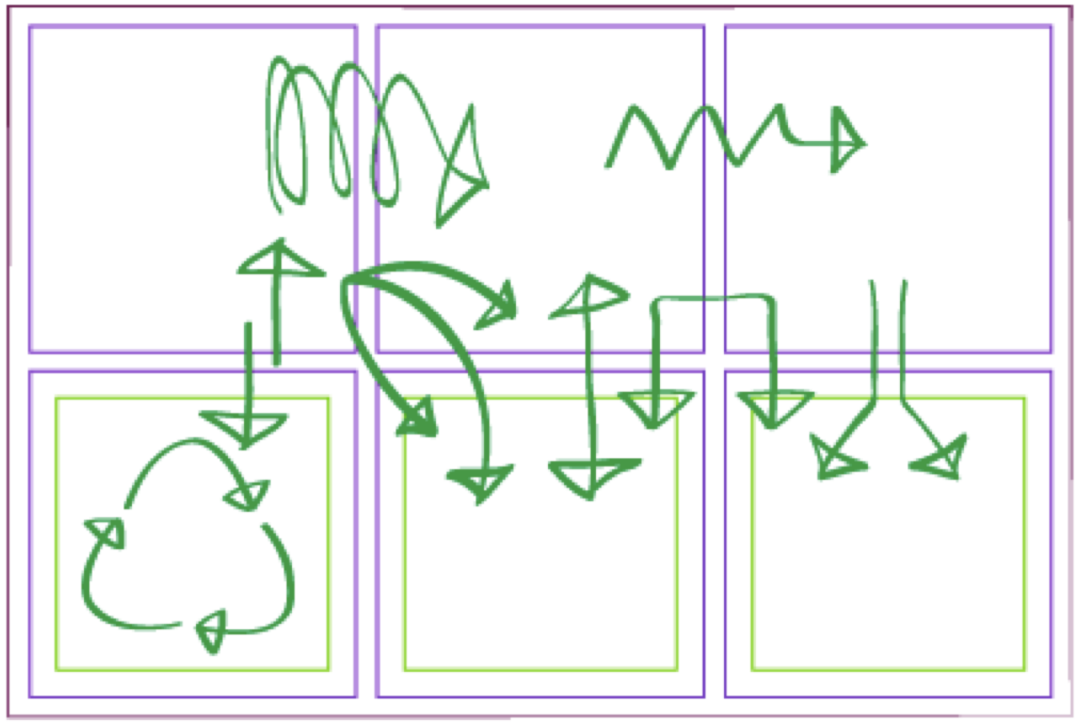


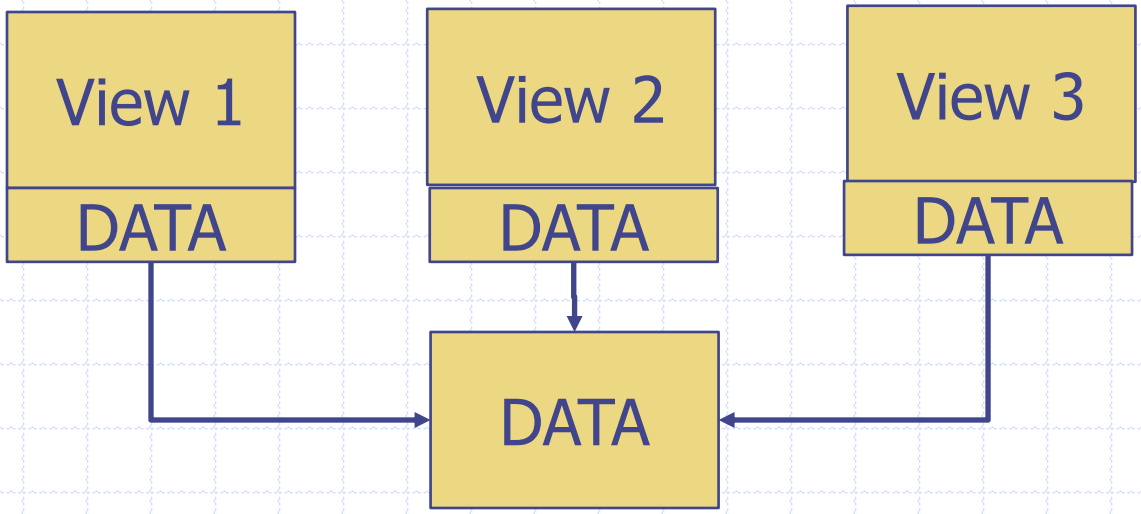
State Management

- One of the main problems with web component frameworks like angular is related to managing application state



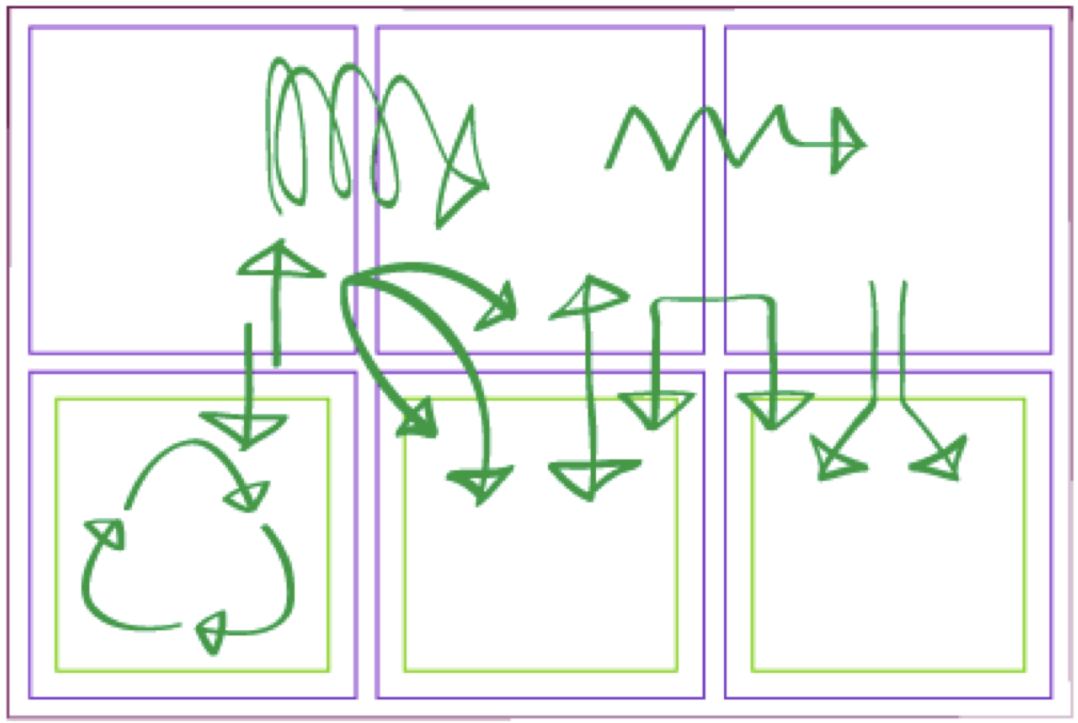
State Management

- Commonly views cache copies of the same data, how do things stay consistant



State Management

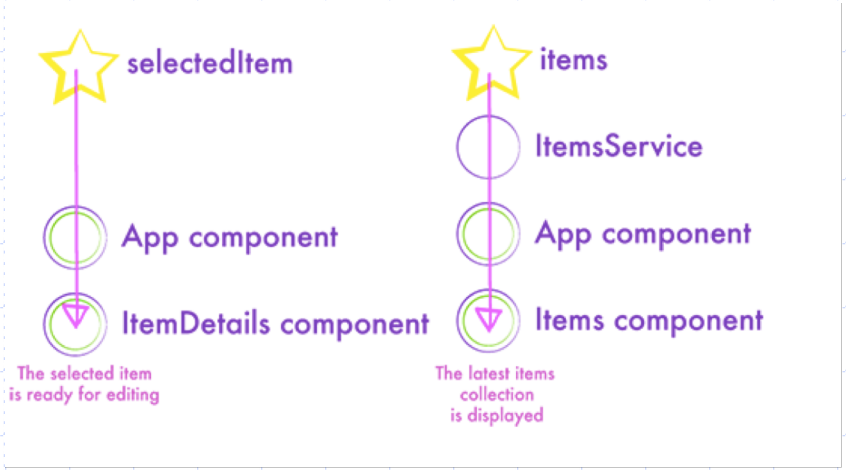
- To keep state manageable, a common best practice is to push state down via properties, and use events to pass state changes up



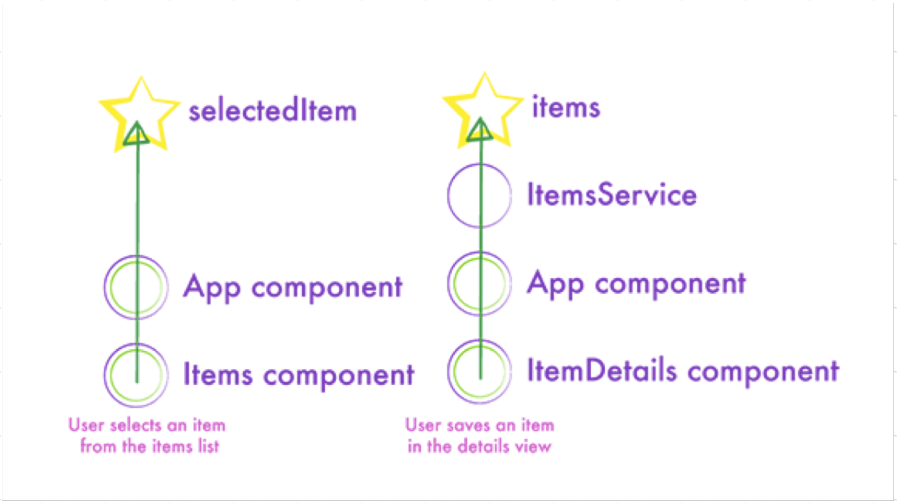
State Management

Pushing State Changes Down, and Reacting to Events Up works well if the components fall into hierarchies

State Down



Events Up



State Management

With more global event management, Angular supports propagating state via, services (singletons), event emitters and observables

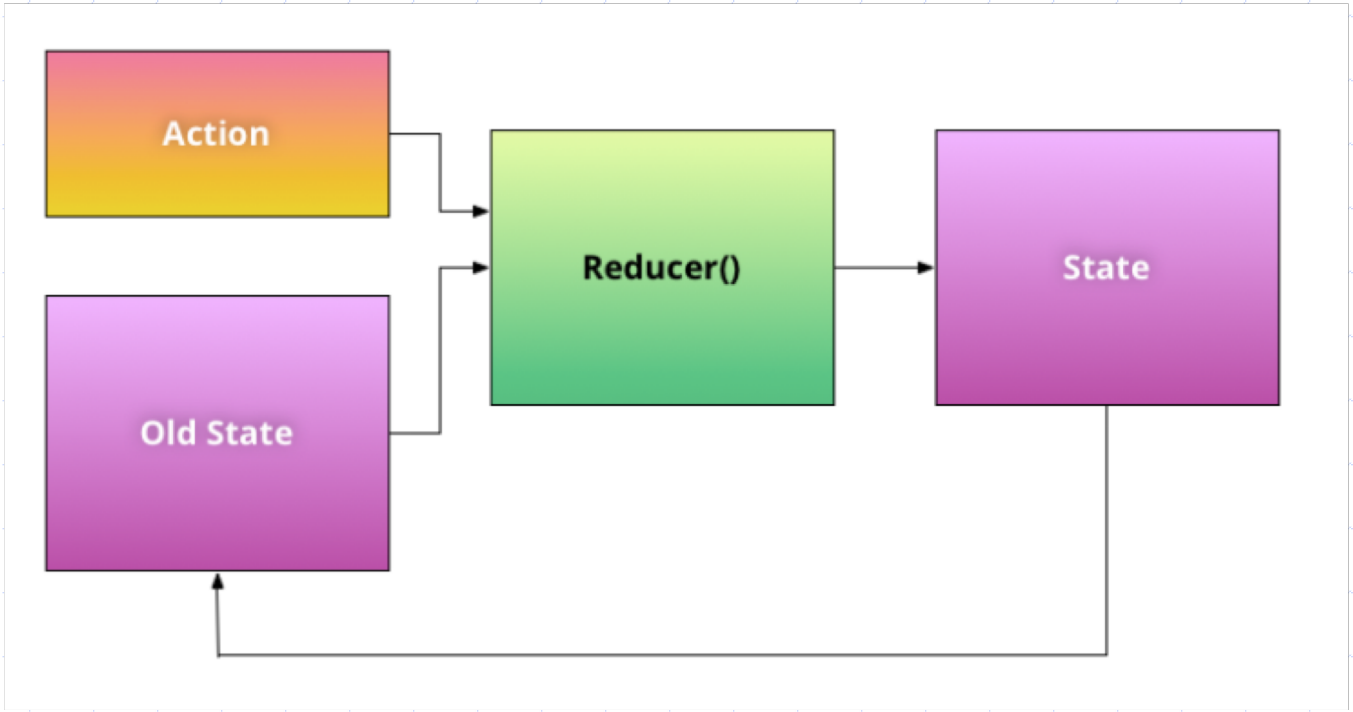
Lets take a look at this, but it gets complex fast…

State Management – Flux / Redux

SEE: http://blog.ng-book.com/introduction-to-redux-with-typescript-and-angular-2//

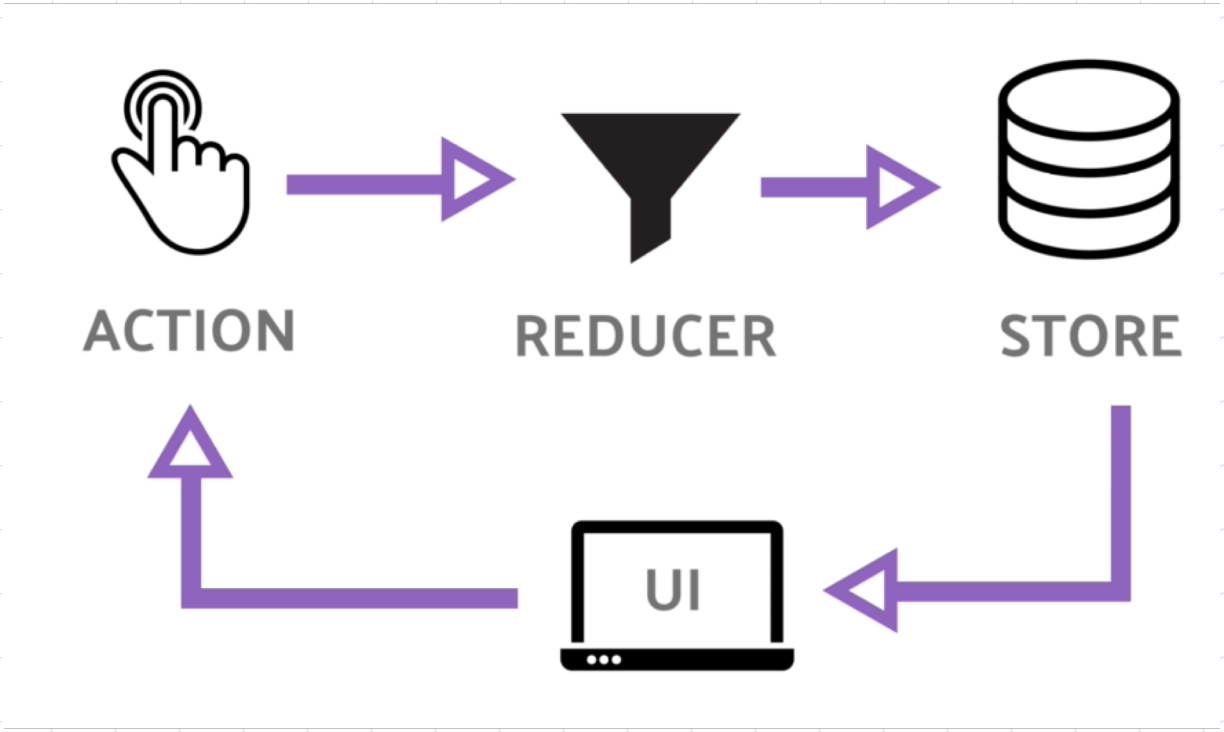
Embrace immutability – functional programming techniques

(Old_State, Action) => New_State

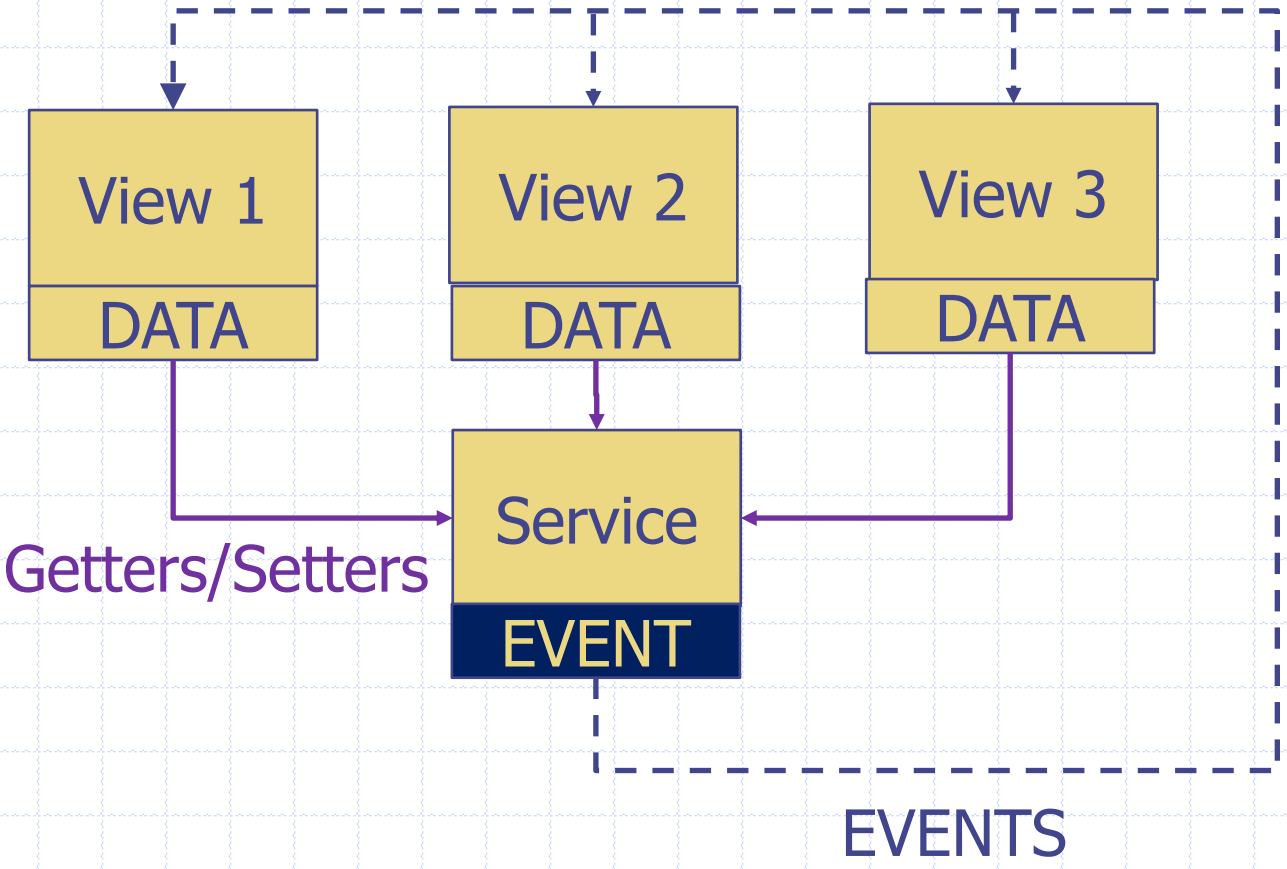


State Management – Flux / Redux

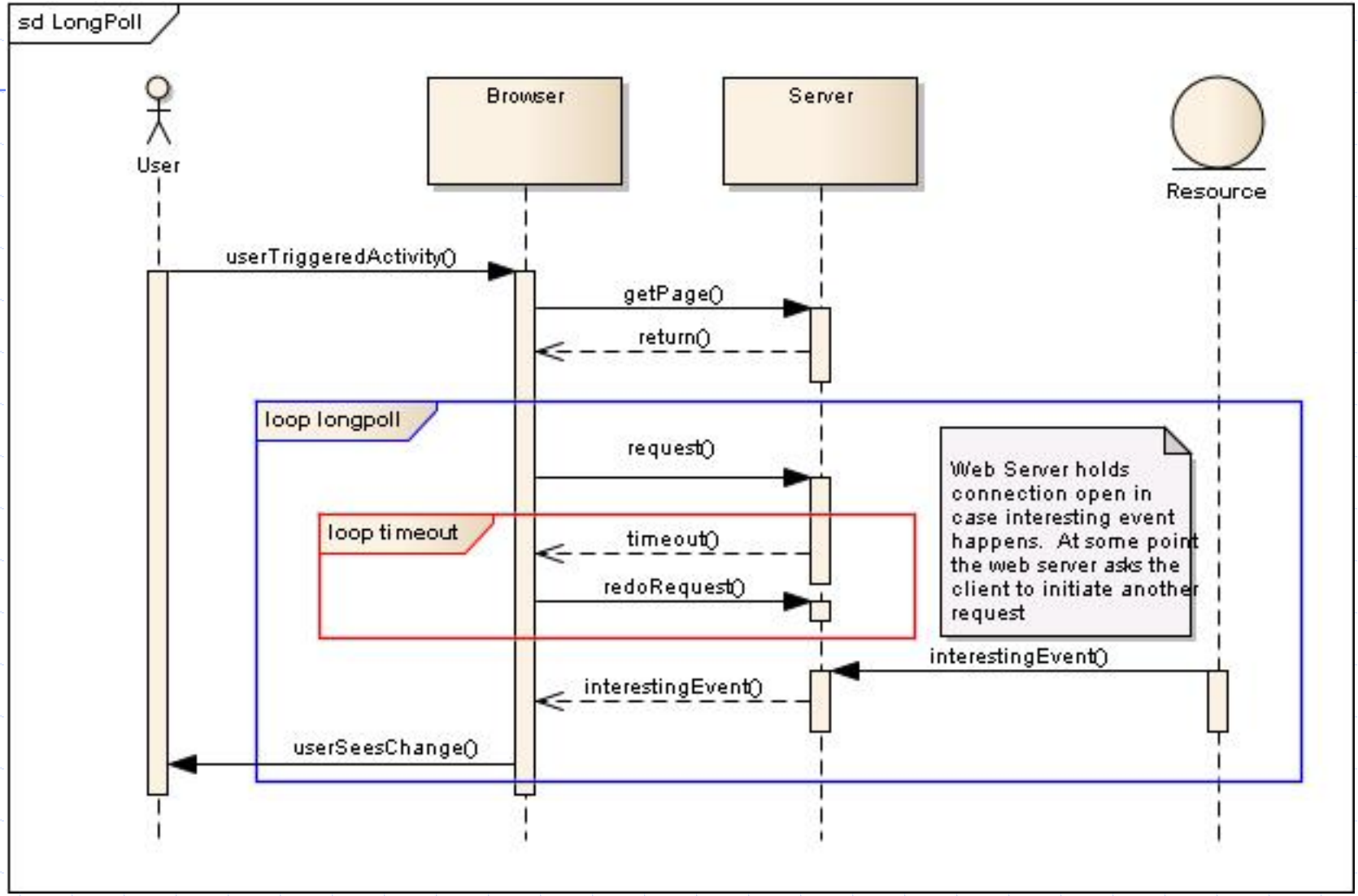
SEE: https://angularfirebase.com/lessons/angular-ngrx-redux-starter-guide/



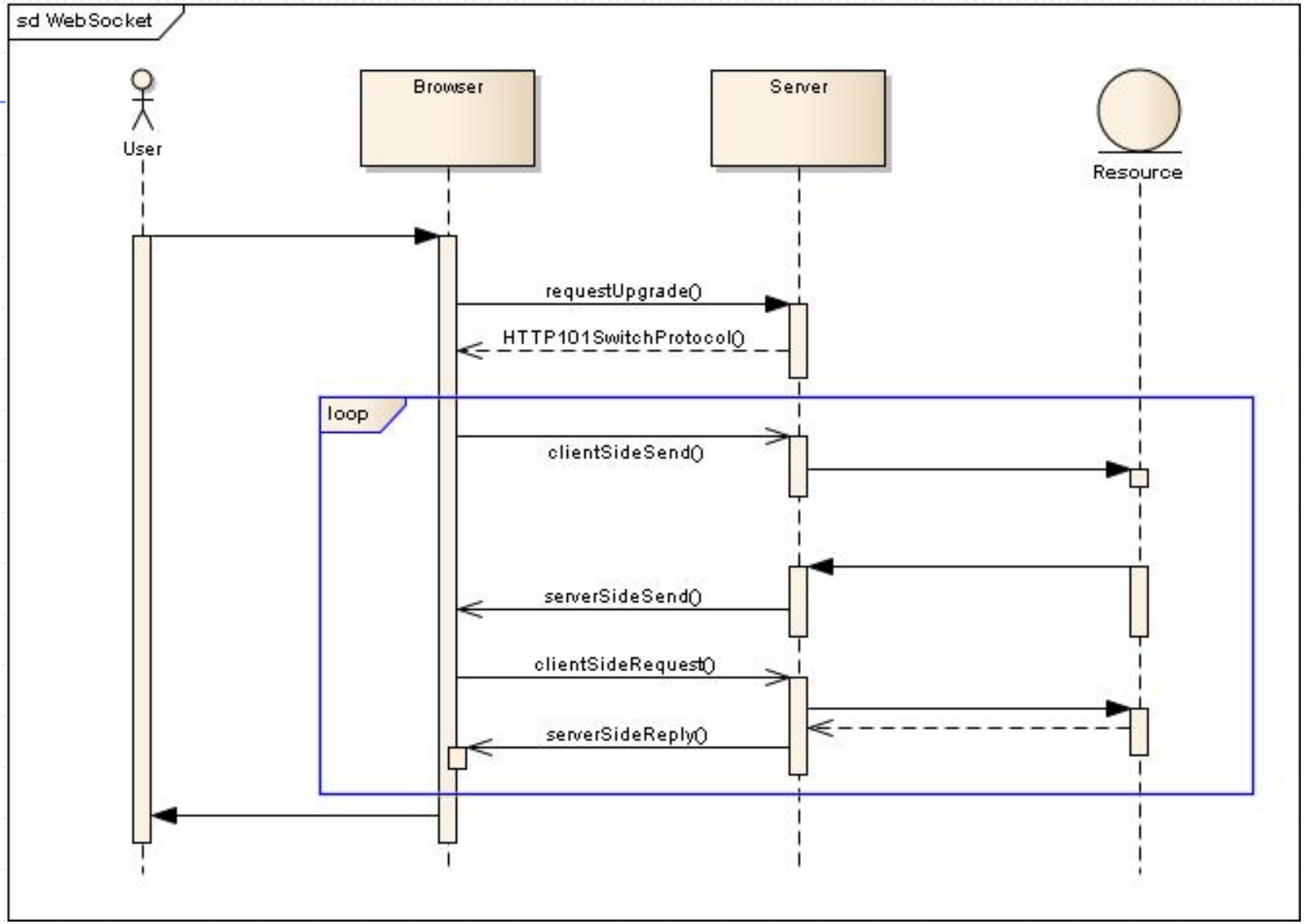
State Management – Shared Services



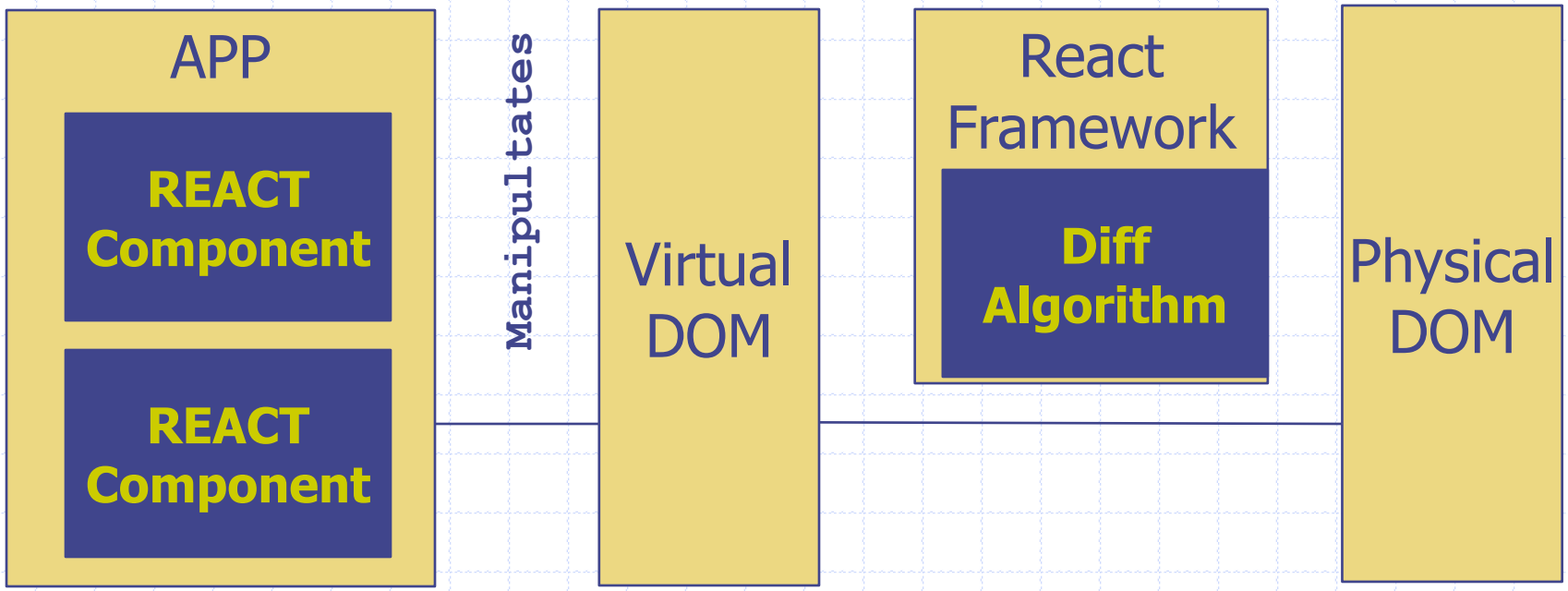
How it works: XHR Long Poll



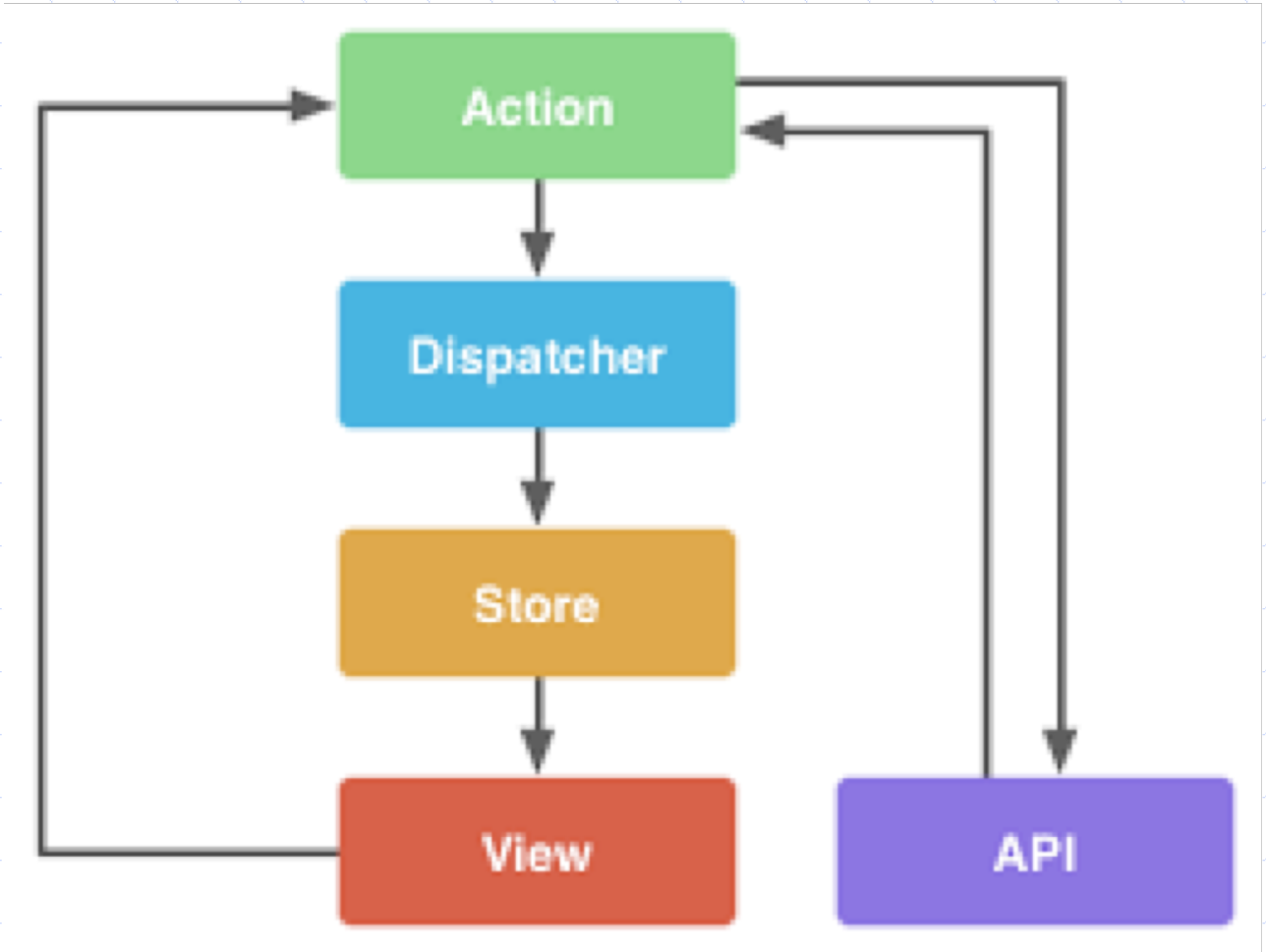
How it works: Web Sockets



React Architecture



Flux Architecture – Data Travels One Way



References

- AngularJS: http://angularjs.org/
- The WebSockets protocol: http://tools.ietf.org/html/rfc6455
- Node.js: http://www.nodejs.org/
- Play! Framework: http://www.playframework.com/