Angular & Ivy Compiler

Ivy is a complete rewrite of Angular's rendering engine. In fact, it is the fourth rewrite of the engine and the third since Angular 2. But unlike rewrites two and three, which you might not have even noticed, Ivy promises huge improvements to your application. With Ivy, you can compile components more independently of each other. This improves development times since recompiling an application will only involve compiling the components that changed.

Ivy also has a very big focus on tree-shaking. This is the process in which the Typescript compiler looks at your code and figures out exactly which libraries are needed and then eliminates any unused code. As a result, the distributed code will be much smaller and the loading times of your application will improve.

Ivy has been around in a preview version since Angular 8, but you previously had to manually opt into using the new engine. With Angular 9, Ivy is the standard engine for rendering your content.

With all these massive changes behind the scenes, you might be scared and wonder how much you would need to refactor your code to be compatible with Ivy. It turns out that the Angular team has made backward compatibility a priority and, in most cases, you should not have to change anything in your application other than updating it to the latest Angular version.

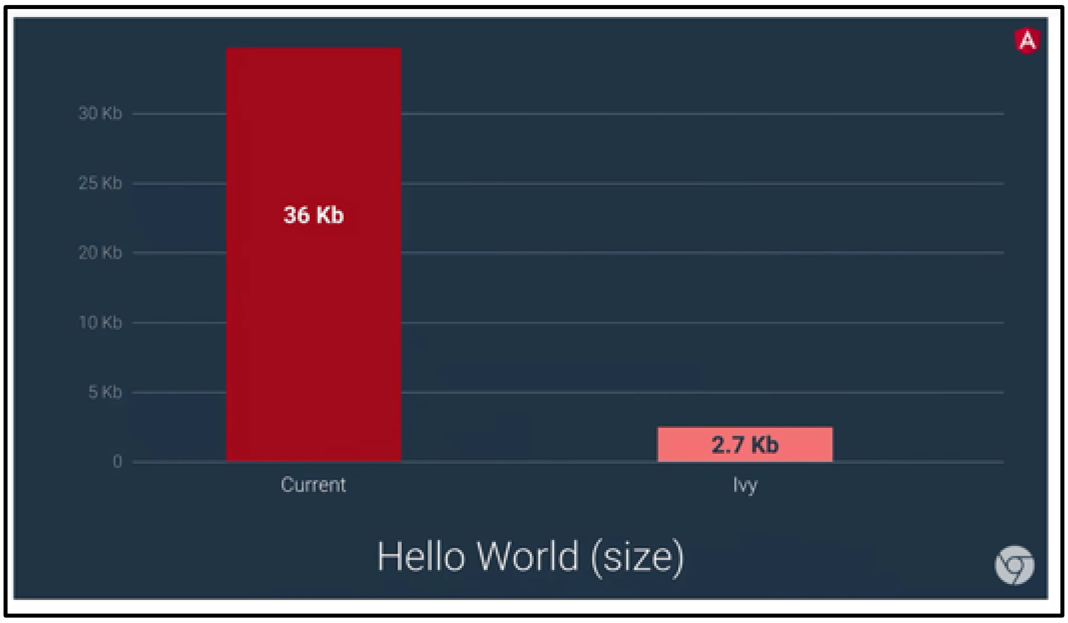
Tree Shaking

Tree Shaking is a term that means removing unused code during bundling process. This can be done by using tools like Rollup and Uglify. During the build process, tree shaking tools use static analysis and eliminates the unused and unreferenced code. However, tree shaking tools have limitations when the conditional code exists as static analysis depends on references. For example, an unused code path within "IF" statement cannot be identified by static analyzer and that code still resides in bundle even if it is not used during runtime. Due to the above mentioned limitations, current rendering pipeline is modified to optimize the bundle size.

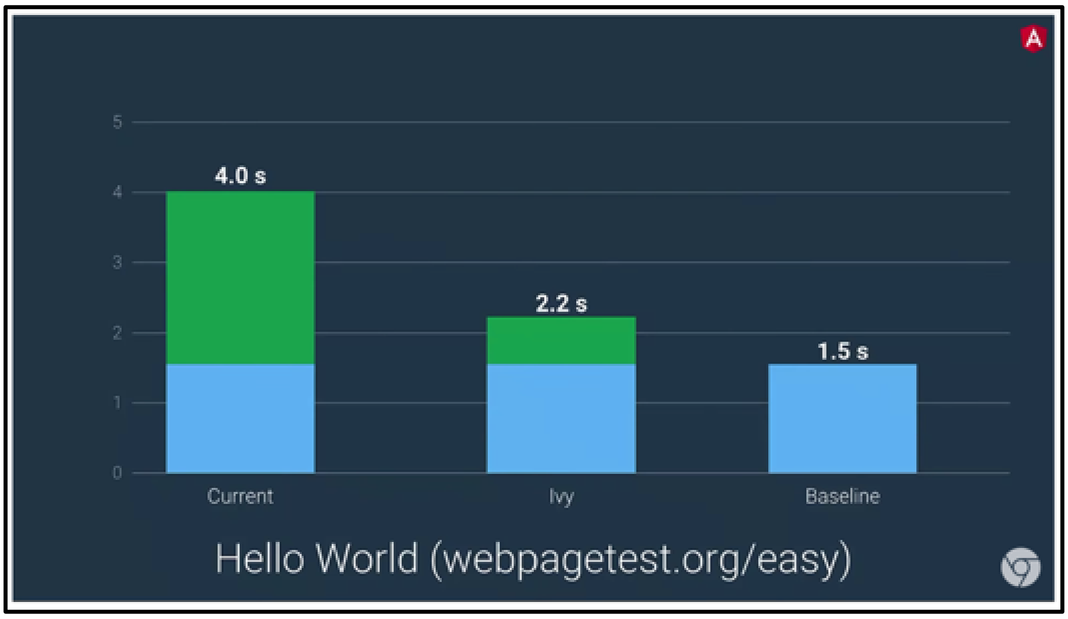
Tree Shaking is applied to Angular features. If any of the Angular features are not used in your code, you don't need to pay for that code

Test Results by Google

Here are results of basic **Hello World** application provided by Google. Current angular generated **36Kb** size of bundle wherein Ivy generated **2.7Kb**, which is **93%** reduction in size.



Google tested the **Hello World** application on mobile devices that have slower network like **3G**. The current application load time is **4.0s** whereas **Ivy** application load time is **2.2s**, which is **45%** reduction in load time.



Google is still in verification process. Once it is done, **Google** will make **Ivy** a default renderer.

To start a new project with **Ivy**, use the **--enable-ivy** flag with the ng new command:

```
npm i -g @angular/cli@latestng update
```

```
ng new angular-ivy-app --enable-ivy
```

To enable/update the existing project to Ivy Compiler:

npm i -g @angular/cli@latestng update

OR in your **tsconfig.json** file update this:

```
{
  "compilerOptions": {
    "module": "esnext",
    // ...
  },
  "angularCompilerOptions": {
    "enableIvy": true,
    "allowEmptyCodegenFiles": true
  }
}
```

angular.json:

```
{
  "projects": {
    "your-project": {
      "architect": {
        "build": {
          "options": {
            ...
            "aot": true,
          }
        }
      }
    }
  }
}
```

Advantages of Ivy Compiler:

1) **Smaller bundle sizes:**
The Ivy compiler has been designed to remove parts of Angular that aren't being used via tree-shaking and to generate less code for each Angular component.

2) **Faster testing:**

In Ivy, **TestBed** doesn't recompile components between tests unless a component has been manually overridden, which allows it to avoid recompilation between the grand majority of tests. With this change, the framework's core acceptance tests are about **40%** faster. We would expect users to see their own application test speeds to be around **40–50%** faster.
TestBed

Configures and initializes environment for unit testing and provides methods for creating components and services in unit test

Note: **TestBed** is the primary API for writing unit tests for Angular applications and libraries. Use **TestBed** in tests. It will be set to either **TestBedViewEngine** or **TestBedRender3** according to the compiler used.

3) **Better debugging:**

Ivy provides you with more tools to debug your applications. When running an application in Dev Mode with the Ivy runtime, we now offer the new ng object for debugging.

Ivy also improves the stack trace for debugging issues such as the ExpressionChangedAfterItHasBeenCheckedError.

4) **Improved CSS class and style binding:**

The Ivy compiler and runtime provides improvements for handling styles. Previously, if an application contained competing definitions for a style, those styles would destructively replace each other. With Ivy, the styles are merged in a predictable way.

5) **Improved type checking:**

The Angular compiler can check more of the types of your application, and it can apply more strict rules. These features will help you and your team catch bugs earlier in the development process.

- **fullTemplateTypeCheck** — Activating this flag tells the compiler to check everything within your template (ngIf, ngFor, ng-template, etc)

- **strictTemplates** — Activating this flag will apply the strictest Type System rules for type checking.

6) **Improved build errors:**

The Ivy compiler makes all of the error messages easier to read. This in turn helps a developer to resolve and fix the bugs at faster rate.

7) **Improved build times, enabling AOT on by default:**

For the first time ever we are using AOT even for DEV mode builds. This means that `ng serve` now benefits from the same compile-time checking as production builds, significantly improving the developer experience for Angular.

8) **Improved Internationalization:**

With Ivy, we're making this faster by moving the build-time **i18n** substitutions later in the build process. This change allowed us to make it up to **10** times faster.

Internationalization is the process of designing and preparing your app to be usable in different languages. Localization is the process of translating your internationalized app into specific languages for particular locales.

Angular simplifies the following aspects of internationalization:

- Displaying dates, number, percentages, and currencies in a local format.
- Preparing text in component templates for translation.
- Handling plural forms of words.
- Handling alternative text.

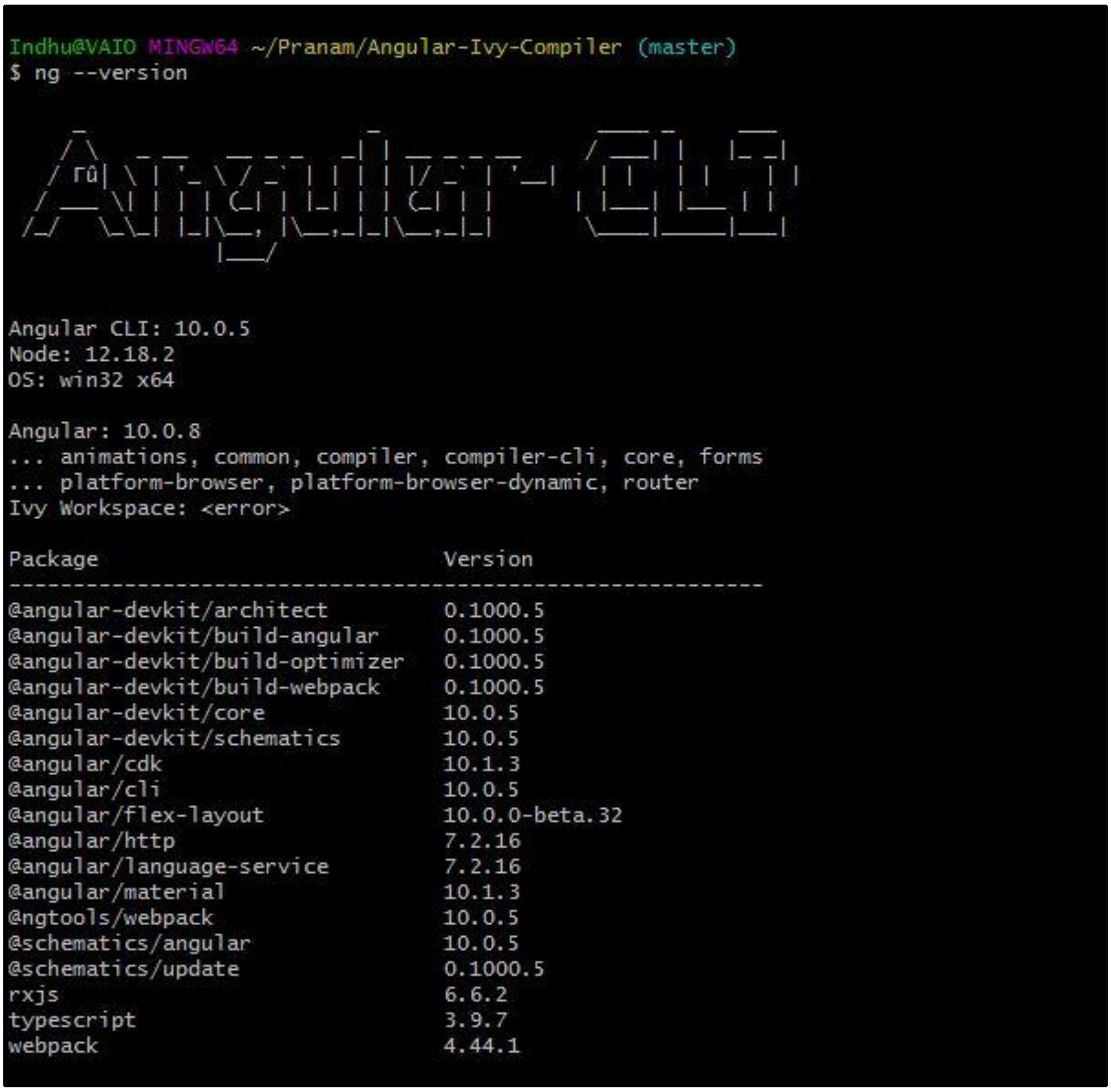
9) **Backward Compatibility:**

Ivy supports backward compatibility so that your existing applications wouldn't break. Today, thousands of applications are using angular framework. You don't need to upgrade angular for Ivy.

Example:

A sample Angular 10 project with Ivy Compiler:

Make sure you have the latest version of Angular:



```
Indhu@VAIO MINGW64 ~/Pranam/Angular-Ivy-Compiler (master)
$ ng --version

     _                      _                 ____ _     ___
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                |___/


Angular CLI: 10.0.5
Node: 12.18.2
OS: win32 x64

Angular: 10.0.8
... animations, common, compiler, compiler-cli, core, forms
... platform-browser, platform-browser-dynamic, router
Ivy Workspace: <error>

Package                               Version
-----------------------------------------------------------
@angular-devkit/architect             0.1000.5
@angular-devkit/build-angular         0.1000.5
@angular-devkit/build-optimizer       0.1000.5
@angular-devkit/build-webpack         0.1000.5
@angular-devkit/core                  10.0.5
@angular-devkit/schematics            10.0.5
@angular/cdk                          10.1.3
@angular/cli                          10.0.5
@angular/flex-layout                  10.0.0-beta.32
@angular/http                         7.2.16
@angular/language-service             7.2.16
@angular/material                     10.1.3
@ngtools/webpack                      10.0.5
@schematics/angular                   10.0.5
@schematics/update                    0.1000.5
rxjs                                  6.6.2
typescript                            3.9.7
webpack                               4.44.1
```
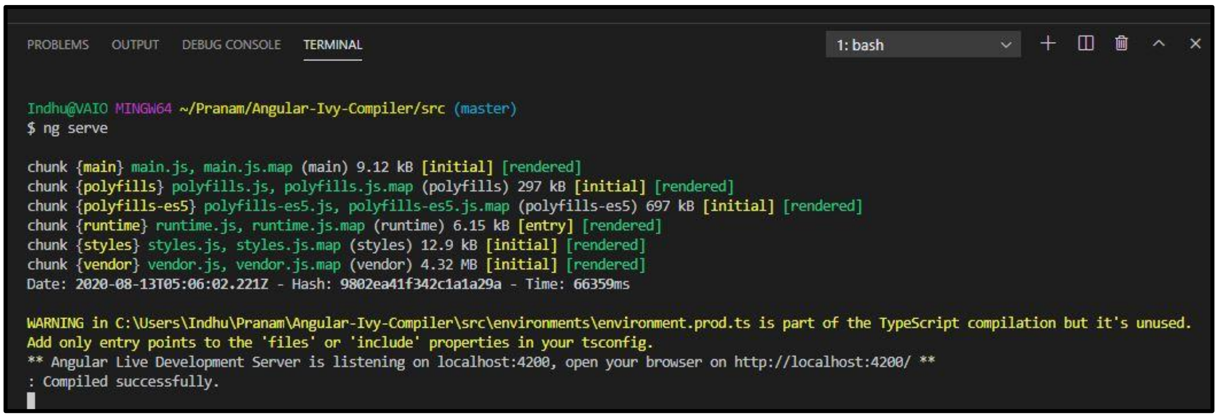
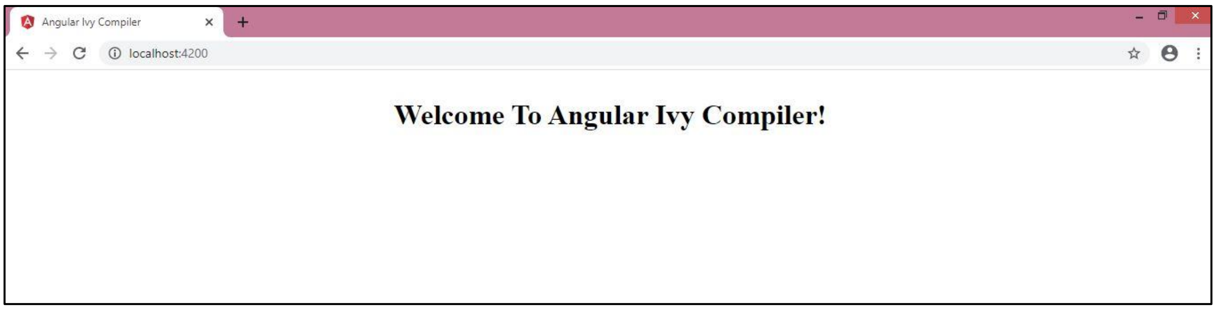

1) git clone https://github.com/PranamBhat/Angular-Ivy-Compiler
2) cd Angular-Ivy-Compiler
3) npm install
4) npm start (or) ng serve



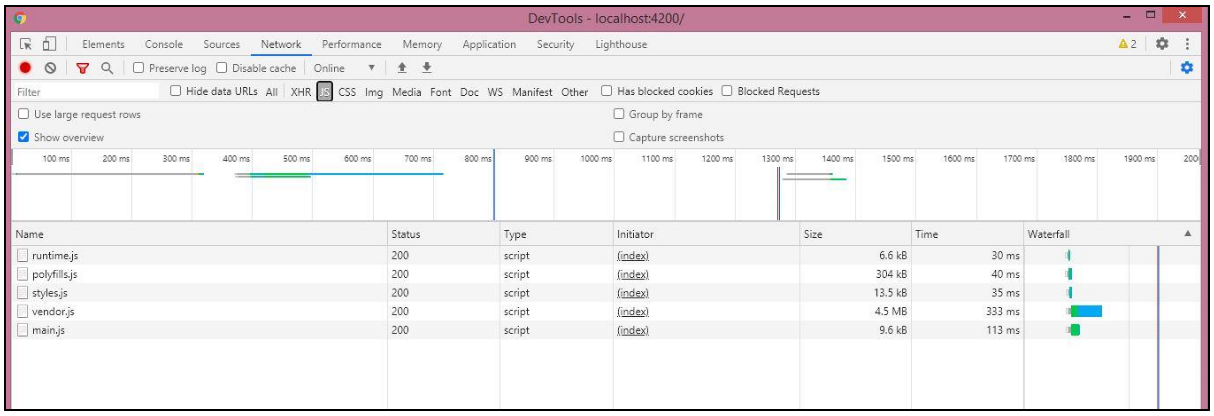
```
Indhu@VAIO MINGW64 ~/Pranam/Angular-Ivy-Compiler/src (master)
$ ng serve

chunk {main} main.js, main.js.map (main) 9.12 kB [initial] [rendered]
chunk {polyfills} polyfills.js, polyfills.js.map (polyfills) 297 kB [initial] [rendered]
chunk {polyfills-es5} polyfills-es5.js, polyfills-es5.js.map (polyfills-es5) 697 kB [initial] [rendered]
chunk {runtime} runtime.js, runtime.js.map (runtime) 6.15 kB [entry] [rendered]
chunk {styles} styles.js, styles.js.map (styles) 12.9 kB [initial] [rendered]
chunk {vendor} vendor.js, vendor.js.map (vendor) 4.32 MB [initial] [rendered]
Date: 2020-08-13T05:06:02.221Z - Hash: 9802ea41f342c1a1a29a - Time: 66359ms

WARNING in C:\Users\Indhu\Pranam\Angular-Ivy-Compiler\src\environments\environment.prod.ts is part of the TypeScript compilation but it's unused.
Add only entry points to the 'files' or 'include' properties in your tsconfig.
** Angular Live Development Server is listening on localhost:4200, open your browser on http://localhost:4200/ **
: Compiled successfully.
```

Go to browser: http://localhost:4200

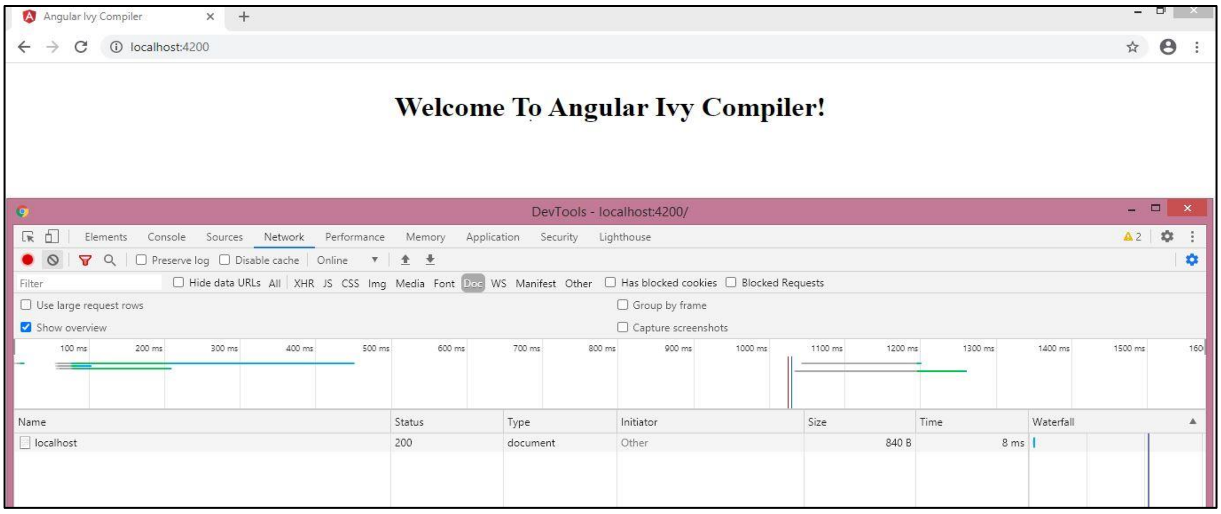


Welcome To Angular Ivy Compiler!

Now see the **Bundle Files**, **Network** and **Timings**:

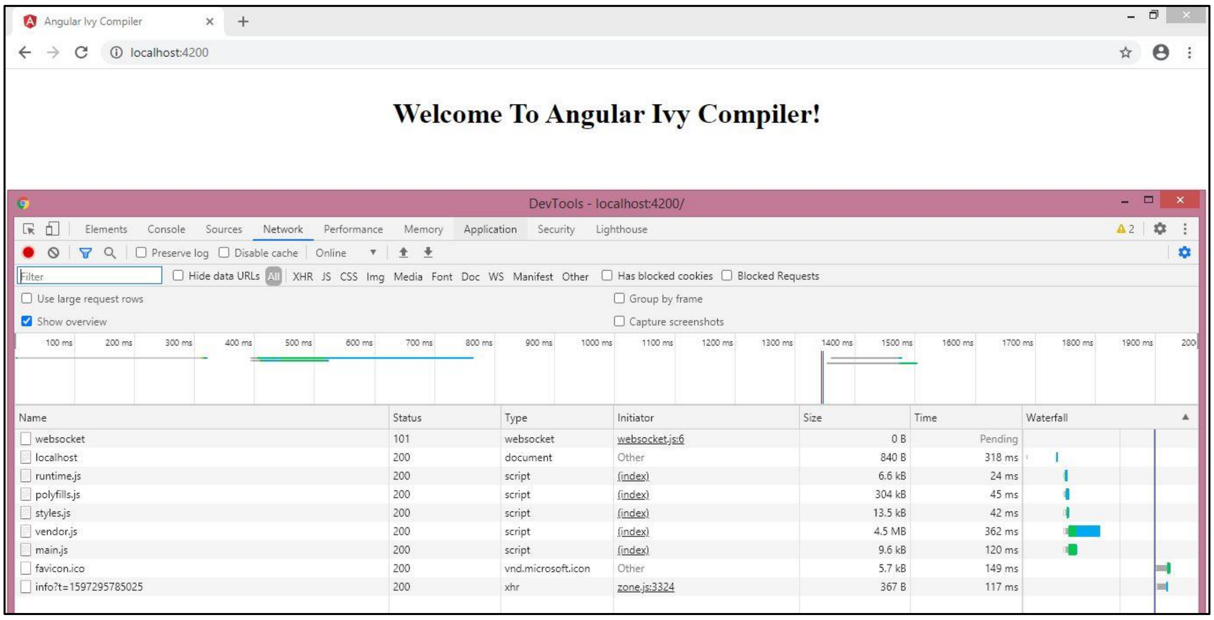


Name	Status	Type	Initiator	Size	Time	Waterfall
runtime.js	200	script	(index)	6.6 kB	30 ms	
polyfills.js	200	script	(index)	304 kB	40 ms	
styles.js	200	script	(index)	13.5 kB	35 ms	
vendor.js	200	script	(index)	4.5 MB	333 ms	
main.js	200	script	(index)	9.6 kB	113 ms	



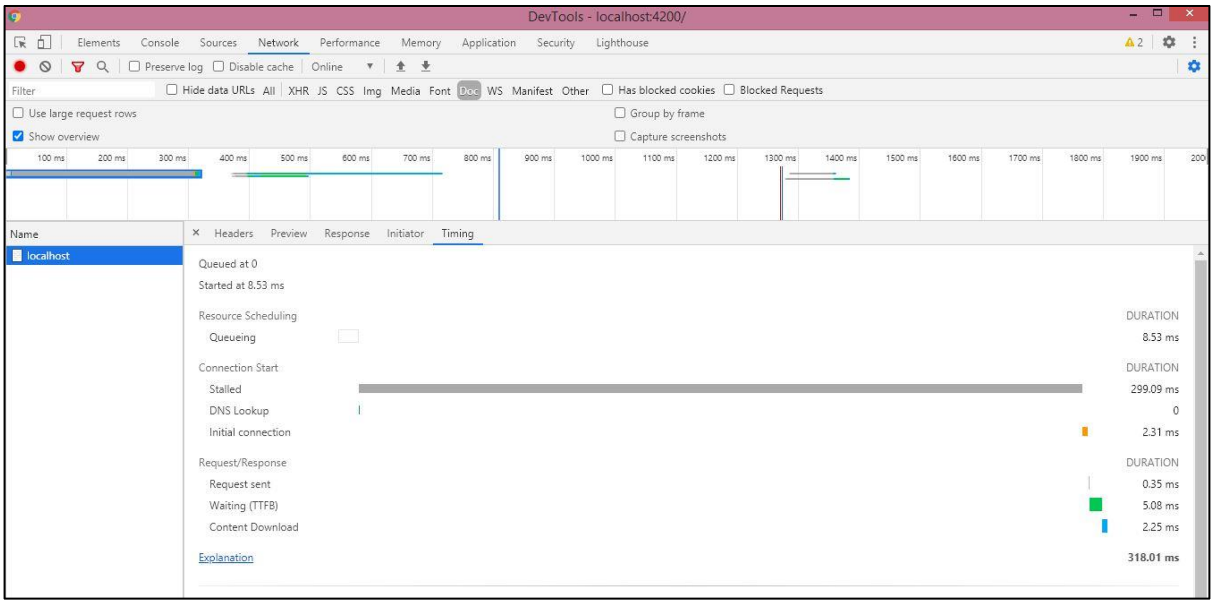
Welcome To Angular Ivy Compiler!

Name	Status	Type	Initiator	Size	Time	Waterfall
localhost	200	document	Other	840 B	8 ms	



Welcome To Angular Ivy Compiler!

Name	Status	Type	Initiator	Size	Time	Waterfall
websocket	101	websocket	websocket.js:6	0 B	Pending	
localhost	200	document	Other	840 B	318 ms	
runtime.js	200	script	(index)	6.6 kB	24 ms	
polyfills.js	200	script	(index)	304 kB	45 ms	
styles.js	200	script	(index)	13.5 kB	42 ms	
vendor.js	200	script	(index)	4.5 MB	362 ms	
main.js	200	script	(index)	9.6 kB	120 ms	
favicon.ico	200	vnd.microsoft.icon	Other	5.7 kB	149 ms	
info?t=1597295785025	200	xhr	zone.js:3324	367 B	117 ms	


DevTools - localhost:4200/
Elements Console Sources Network Performance Memory Application Security Lighthouse
Preserve log Disable cache Online
Filter Hide data URLs All XHR JS CSS Img Media Font Doc WS Manifest Other Has blocked cookies Blocked Requests
Use large request rows Group by frame
Show overview Capture screenshots
Name
localhost
Headers Preview Response Initiator Timing

```
Queued at 0
Started at 8.53 ms

Resource Scheduling                 DURATION
  Queueing                           8.53 ms

Connection Start                    DURATION
  Stalled                          299.09 ms
  DNS Lookup                               0
  Initial connection                 2.31 ms

Request/Response                    DURATION
  Request sent                       0.35 ms
  Waiting (TTFB)                     5.08 ms
  Content Download                   2.25 ms

Explanation                        318.01 ms
```

Conclusion:

As we can see, the bundle file size, network connectivity/loading speed and overall timings are much faster than Angular old versions. With Angular 10 and Ivy Compiler we can run any application effectively by keeping efficiency and quality in mind.