# Development testing

TODO: should I have a sort of “concluding” paragraph under each level 3 subsection?

This chapter will focus on the implementation of the test application described in chapter (TODO: crossref testapp methodology). Each framework has its own subsection where I describe every aspect of the development and thoughts I made during the process. Each section has its own summary, and finally, there is a conclusion giving a nuanced look at what framework solves the different tasks of a real-time application best.

## Socket.IO

Socket.io is a module for Node.js (TODO: nodejs) that provides real-time through pure JavaScript on both server and client. It has been around since 2011 (TODO: last commitpage)[[1]](#footnote-1), and it aims to provide clean and simple real-time across all platforms:

*“Socket.IOaims to make realtime apps possible in every browser and mobile device, blurring the difference between the different transport mechanisms”.*

While it hasn’t reached 1.0 yet (TODO: check), it is used in production code by several companies, and it is considered stable. Perhaps one of the most “famous” applications that use Socket.IO is Trello – the online “Scrum Board”[[2]](#footnote-2).

TODO: made by + licence (open source, free)

As mentioned, Socket.IO is a module for Node.js. But what exactly is Node.js? As the name implies, it has to do with JavaScript. More precisely, Node.js is a framework for building network applications using JavaScript. In other words, it is the framework that has made JavaScript enter the realm of backend languages like C# and Java.

Node builds on Google Chrome’s JavaScript runtime (TODO: nodejs) and the project has been around for some time. Still, it is not finished and is currently (TODO: write date?) in version 0.10.15. However, its Documentation has indicators on each aspect, showing how stable it is, hence making it rather easy to use in a safe way.

### Why I chose it

Node.js is increasingly popular, and the idea of using JavaScript on the server is very exciting! Over the past couple of years, there has been a dramatic change in the way developers think of JavaScript (TODO: sources). Therefore, it was only natural that I chose at least one framework that uses Node.js as server.

Though there are several modules for Node that provides real-time (TODO: link to node modules), Socket.IO stands out from the crowd. It seems to have the largest community, as it is frequently featured at conferences and generally mentioned many times in traditional forums like Stack Overflow[[3]](#footnote-3).

Furthermore, Socket.IO feels like more than just a Node module. It has its own homepage (TODO: homepage) with some examples and demos–all presented in a good looking and easy to understand fashion. I feel this gives Socket.IO a more professional impression, which makes it stand out even more from some of the other modules that exist that seem more like something someone threw together in a hurry.

Socket.IO doesn’t have a lot of documentation, but what it has gives users a quick overview of the module and how to use it. The API documentation (TODO: docs) uses code samples, which I find more useful than a so-called “wall of text”. There is also a wiki page (TODO: wiki) to give information beyond the API documentation.

As stated in the quote from Socket.IO’s homepage in the introduction to this section, Socket.IO strives to blur the difference between the different transport mechanisms. WebSockets is the preferred transport, but if the client doesn’t support it, Socket.IO will fall back gracefully[[4]](#footnote-4) to one of the following transports:

* Adobe Flash Socket (TODO: source), which uses, surprise, Flash to establish a TCP socket connection between the client and the server, thus “mimicking” a WebSocket connection.
* Ajax multipart streaming (TODO: source): An alternative streaming technique to the forever frame technique described in section (TODO: crossref AND should I write this in the essaypart?).
* Forever Frame
* JSONP Polling, which is polling with data type set to JSONP. This allows cross domain requests; something that is not allowed in normal HTTP Polling (TODO: same source as multipart).

TODO: table, summarize why I chose it?

### How it works

TODO!

### Getting started

Having Node.js installed on your computer, installing Socket.IO is done via a simple command to the Node Package Manager (*NPM*)[[5]](#footnote-5). After that you can require it in any JavaScript file in your project (TODO: codelisting).

If you are new to Node.js, the learning curve is somewhat steep. However, this is almost always the case for other frameworks (not just real time frameworks) as well–it is expected that you know how to use the underlying technology.

Still, Socket.IO provides only simple examples, that demonstrates quite simple behavior, on their homepage (TODO: source) and on GitHub (TODO: source). All of these uses just a single HTMLfile, and a single JavaScript file on the server, a case which is quite uncommon in normal web applications. I missed some more information about how to build more complex apps, or at least some more reference to the other frameworks that are used in Socket.IO’s examples (like Express (TODO: source)).

### Coding environment

As JavaScript code is traditionally just the client part of a web application, it is often written in the same editor as the server code[[6]](#footnote-6). That may be why most of the examples I could find in videos throughout the web either use a Linux based text editor like Vim or Emacs or the excellent Sublime Text[[7]](#footnote-7), a cross platform editor that has become increasingly popular.

There is also an IDE provided by JetBrains[[8]](#footnote-8) under the name of “WebStorm IDE”, which is designed specifically for JavaScript, HTML and CSS. It also has a plugin that allows for Node.js development. This is the environment I chose to use, as it gives good IntelliSense (TODO: explain + crossref appendix), has good syntax highlighting and lets you debug Node.js applications (TODO: figure).

When it comes to debugging, there are a number of options with Node.js applications in addition to WebStorm. Since Node.js is built on Chrome’s JavaScript Runtime (TODO: ref Node’s homepage), that exposes an extensive debugger over TCP, you can build your own debugger. This is exactly what has been done with the Node Inspector (TODO: ref Git). Using this, you can use Chrome’s familiar in-browser debugger to debug your Node.js code (TODO: figure). I actually found this to work better than the WebStorm debugger for certain cases, especially with functions that were used to get back data from a database.

Another option is to use the debugger that comes bundled with Node.js. This is a command line tool that was surprisingly easy and intuitive to use. However, it requires you to write the keyword “debugger”, in your code instead of setting breakpoints (TODO: codelist), so it really only works for simple cases, where you don’t have to clean up a lot of lines with “debugger” afterwards.

Running a Node.js application is normally done via the command line. You just simply “node” (TODO: cmd list) the main file of your application and navigate to the port it is listening to in the browser. However, when using WebStorm you get the more traditional option of pressing a play button. All output that would normally show in the console, then appears within the IDE’s output instead (TODO: figure)–something I found helpful since it meant one less window to toggle between while testing the application manually.

### Code structuring

Perhaps the most unfamiliar aspect of JavaScript compared to other languages, is the fact that it is asynchronous (TODO: examplecode)[[9]](#footnote-9). A common pitfall for JavaScript frameworks is to not fully disclose, either via documentation or function names, whether a function is asynchronous or not. With Socket.IO this is, thankfully, not the case. Socket.IO follows the WebSockets protocol tightly as it provides and event based architecture, and events are always asynchronous. While the WebSockets API only provides a few, standard events (TODO: crossref), Socket.IO lets you used self named events in addition to the standard WebSocket API events.

With traditional, object oriented, languages like Java and C#, code is structured into separate classes, which are normally given their own files. In Node.js, code is structured through the use of modules. Modules is a natural way of separating code within different domains[[10]](#footnote-10), and it is also a very nice way of separating logic that can be used in other applications (TODO: require code list). Furthermore, modules can depend on other modules, which makes you able to build your application using modules as small building blocks. This is how Socket.IO is built up–it is a module, but it depends on a lot of other, smaller modules.

This modularization has both good and not so good aspects. The best aspect of the modularity is diversity: If you need some functionality, for instance a module for communication with a MySQL database, you will almost always not just find it, but find many different alternatives. Using modules also allows for an easy way to contribute to Node.js by making your own modules. This allows for a rather rapid growth of the Node.js project.

However, with so many modules, and seemingly little quality control, developers might end up using quite some time just to find a module that fits their requirements. Furthermore, some modules that are displayed on Node.js’s module page (TODO: source), are no longer maintained, which easily can cause problems if you have used it in production code and a bug arises.

Another problem is that modules often tend to favor the use of other modules in their examples and other documentation. This was also the case for Socket.IO, which mostly uses Express. That meant I had to learn more than what I set out to do.

### Serialization

When working with JavaScript on the, client the preferred serialization format is, in my opinion, *JSON* (JavaScript Object Notation). With Socket.IO, which uses JavaScript also on the server, I expected serialization to be automatic and abstracted away from me as a developer. Luckily, I was not disappointed, as this is exactly how Socket.IO has solved serialization of objects. When sending data back and forth, one simply sends values, objects or arrays without concern of how they are serialized or deserialized (TODO: codelist). The only problem I had, was when sending Date objects back and forth. This was not Socket.IO’s, nor Node.js’s fault, though, as it has to do with how JavaScript handles deserialization of Date objects[[11]](#footnote-11).

### Maturity

Socket.IO is not supported by any large company or otherwise backed by near endless funds. It was started by mainly one person, who is still the largest contributor to the project. It hasn’t reached version 1.0 yet, and development seems to be slowing to a crawling pace (TODO: source - git).

Nonetheless, Socket.IO seems very stable and, as I have said, is used in production code (TODO: crossref 1.1). The fact that development has slowed down, may just be a sign that the framework is near complete and very bug free (still, there are quite a lot of issues reported on github(TODO: source)).

However, I must say that I am a little concerned regarding the state of the project. As I said, development seemed to have reach a crawling pace with no new releases recently. The GitHub page states that version 1.0 is just around the corner (the documentation there is even updated to fit this version), but as this is being written, version 1.0 has been “upcoming” for nearly a year.

When it comes to Node.js in general, it is still not a proven platform for large scale applications. Nor is JavaScript itself for that matter. However, building larger applications client side with JavaScript has become more common, but it remains to be seen if the language can make its way onto the server.

Today, I don’t think anyone is willing to gamble on choosing Node.js as their primary server solution. However, if some real time functionality is needed, there is no problem using Socket.IO for this, even if the primary server is something else than Node.js. Then, if Node.js doesn’t catch on, one can replace it with something else without having to change the entire application.

Delivering real time is something I believe Socket.IO does well, and I must say that I am really excited to see how Node.js will pave the way for JavaScript on the server. If the road ends up full of pot holes or not, remains to be seen.

### Documentation

My first impression was that Socket.IO didn’t have a lot of documentation, but that what it had was enough. Mostly this is actually true. However, the problem occurs when dealing with the modularity of Node.js. The documentation should do a better job of pointing you in the right direction when it comes to functionality provided by other modules. Because of how it is now, I had to search around a lot and do some trial and error to achieve something as simple as serving the client with multiple files and not just a single “index.html” file as in every single example provided by Socket.IO’s documentation (TODO: codelist multiple files and socket.io example).

Node.js itself has a lot of documentation that is well authored. It is also mostly example based, which makes it easier to understand certain aspects. I actually didn’t think of the importance of Node.js’s documentation before I started working with Socket.IO. But just as it is common to need guidance about core functions of the .NET framework when working with C#, you cannot get by with a Node.js module without getting reference about core features of Node.js itself.

### Implementation of test application

As Socket.IO doesn’t offer any kind of client side template language, the test application was built using the common UI using Knockout (TODO: as described in.. + ref to git?). The application was build using Node.js version 0.10.8 and Socket.IO version 0.9.11.

To structure my application and harness the asynchronous control flow, I chose a technique that is very common in the asynchronous world, namely promises (TODO: codelist)[[12]](#footnote-12). The use of promises in JavaScript hasn’t been standardized, but most strive to follow one specific proposal (TODO: source). I chose a module for promises called promised-io by Kris Zyp (TODO: source), which closely resembles the client side implementation that JQuery provides (TODO: jquery deferred).

The application’s requirements specification (TODO: crossref), states that the application should utilize MySql as database engine. As with everything else in Node.js, I had several different modules to choose from. Felix Geisendörfer’s node-mysql was chosen because it had the most comprehensive documentation and it also seemed simple and intuitive to use. No problems arose during development regarding the use of this module, so I still believe that it was the right choice.

There aren’t many examples at Socket.IO’s homepage regarding how to provide the client with the needed files. That is not within the scope of Socket.IO’s functionality either, so it isn’t really a big drawback. Nonetheless, I still had to find out how to provide the client side of my application with several files, not just a single HTML file, which is the case in all the examples. Since Socket.IO seemingly recommends Express (TODO: move footnotes?), I chose to use it as well. Express is a web application framework, but for my use case, it was simply used to create the web server of my application (TODO: codelist).

When it comes to browser support, Socket.IO seems to hold what it promises (TODO: crossref). It works fluently in all browsers (TODO: crossref to methodology fallbacks), and it is all handled by Socket.IO behind the scenes.

### Testing

I was inexperienced in writing JavaScript code in general, but when it comes to testing in JavaScript, I was completely new. Still, it proved to be rather familiar once I got the gist of it. As with every other aspect of Node.js, there are a lot of choices when it comes to testing frameworks. My choice fell on the test runner Mohca (TODO: mocha) as it seemed like a good and stable choice[[13]](#footnote-13). For assertions, there was also a lot of choices, but I landed on Should.js (TODO: shouldjs or should.js + source) which was one linked from Mocha’s homepage..

The modularity of Node.js makes it easy to separate small, testable units for unit testing. With Mocha, writing tests for asynchronous code is also very simple. Actually, I was rather surprised with how easy it was to write JavaScript tests, as I have heard a lot of murmuring from different people in the business, that really don’t like writing tests for JavaScript.

Integration testing Socket.IO is actually very little painful. Many frameworks cannot be thoroughly integration tested without involving a browser. Socket.IO provides a client module for Node.js which can be used in test code. That means that you can establish a connection to the server from your test code (TODO: codelisting), without initiating a browser first, something that makes the tests a lot more effective and easy to write and understand.

### Summary

Socket.IO is a very solid framework that delivers what it promises (TODO: crossref intro quote). It has seamless fallbacks that enables it to function across all major browsers. Furthermore, it is simple to understand and use, and it is seemingly very stable. The documentation could be a little more comprehensive, and I have some small concerns regarding the pace new releases has come out over the past months. However, this is more likely caused by the fact that Socket.IO is near completion.

TODO: table? Good at, Bad at?

## Lightstreamer

Lightstreamer is a framework made in Java that provides a server specialized for real time applications. The server can communicate with a number of other server technologies via a clever adapter based architecture (TODO: figure). Due to this structuring, you can integrate Lightstreamer with virtually any existing system, as long as the language is supported by it. Currently, Lightstreamer provides adapters for Java, C# and JavaScript (Node.js). You can even integrate with other languages via the adapter “Remoting Infrastructure” (TODO: doc), though this is actually raw TCP sockets, so it is pretty low level code, and probably a little more work than integrating with a more traditional language adapter.

Client side, Lightstreamer supports numerous different platforms, including a JavaScript API for web applications, several desktop APIs in Java and C#, numerous mobile device APIs and even a generic client that is more low level (TODO: doc).

Behind Lightstreamer is an Italian software company named Weswit, which is actually one of the most experienced companies in the world when it comes to delivering software for making real time applications. Lightstreamer was released as early as 2000 (TODO: ppt about real time), and was one of the first attempts at delivering real time push in web applications without utilizing Java Applets (TODO: wikipedia).

Lightstreamer, unlike the other frameworks in this thesis, is a commercial product. However, they do provide a free license, which is the one I have utilized in my work.

### Why I chose it

First of all, Lightstreamer is completely different from all the other frameworks I have found. It is a commercial product from a rather large, European company that has a lot of customers worldwide. Furthermore, no other framework has been on the marked for as long as Lightstreamer, which gives me an unique opportunity to find out how much experience can influence the performance and usability of a real time framework.

As I mentioned, Weswit has a lot of customers worldwide, and if I have interpreted their homepage correctly, Lightstreamer is their only product (TODO: what we do). That means that Lightstreamer is used by a lot of companies in numerous solutions on the web, which is also indicated on the Lightstreamer homepage (TODO: homepage). It is even used by NASA to provide real time telemetry data for the International Space Station (TODO: article from NASA)!

Being a professional product and not “just a GitHub project” give rise to certain demands regarding the documentation of the framework. A well written and explanatory documentation is of course always preferable, but it is even more so for a product people actually pay for. With Lightstreamer, Weswit have obviously had this in mind–there are tons of documentation covering both the server side adapters and the client side APIs.

Another aspect you don’t necessarily get with a non-commercial product is support from the developers or forums. Lightstreamer hosts their own forum on their homepage[[14]](#footnote-14), in which representatives from Weswit frequently answers questions from users. There are also some activity on more general forums like Stack Overflow and Google Groups.

Finally, Lightstreamer, of course (TODO: as of section crossref methodology) supports every major browser. This means that it supports fallbacks to WebSockets, but I have not been able to find out exactly which. Their data sheet is the closest I have found mentioning Comet and HTTP streaming. As I wrote in section (TODO: crossref comet essay), HTTP streaming is covered by the Comet umbrella term, so I’m guessing that they mean some other form of HTTP based real time technology than streaming when they write Comet. A Norwegian blog post suggests that one of the fallbacks is long polling (TODO:allekonsulentene), which makes sense given the separation of HTTP streaming from Comet in Lightstreamer’s docs. Nonetheless, there is fallback support which is what really matters. How it works in practice remains to be seen.

But before I delve into the testing of the framework itself, I need to make some disclaimers. First, I have used the free license of Lightstreamer that does not come with all features included[[15]](#footnote-15). Furthermore, I used the Lightstreamer server itself as application server, which is not the recommended course of action when using Lightstreamer. I chose to do it this way, mostly to keep all the implementations of the test application as similar in architecture as possible. Furthermore, it is generally the case that you would separate the real time aspects of any application to its own server. In this thesis, the purpose is not to implement the whole architecture of a real time enabled web application–just the real time aspects are relevant.

### How it works

Lightstreamer incorporates a publish and subscribe model where clients subscribe to items. In this context and item is generally a collection of items (like a database table), for instance can an item be the products in an online auctionhouse.

Using an adapter based architecture makes Lightstreamer easy to incorporate with almost any system. To achieve this, an application using Lightstreamer has to have one metadata adapter and one or more data adapters (TODO: figure or crossref to previous figure).

The metadata adapter’s responsibilities include registering subscriptions to users, authenticating and filtering client communication to the appropriate data adapter. In my use case, the metadata adapter mostly routes messages to the data adapter(TODO: codelist).

While the metadata adapter handles incoming communication with users, the data adapter(s) keeps track of the individual items that users can subscribe to. When an item is updated, the data adapter is normally notified via an event listener that handles sending the updates to the clients (TODO: codelist).

On the client, Lightstreamer provides its own grid based template syntax in HTML (TODO: codelist). Furthermore, the framework ships with a JavaScript library for handling these grids and subscriptions. The template engine of Lightstreamer is made to handle received updates on the items the clients subscribes to–there are no mechanisms equivalent to those offered by for instance Knockout, which means that you have to do a lot of UI updates manually via for instance JQuery.

### Getting started

Obtaining a free license for Lightstreamer wasn’t particularly hard; just fill in a form and you are good to go. Downloading and installing too, was just as you would expect from a well functioning piece of software.

Learning about it and how to use it started out very gently, but it soon proved to be more difficult than what I had hoped. There is only one tutorial for a “Hello World” application that, while it is very informative, doesn’t really offer too much help when it comes to making something a bit more complex. To help developers move on from the “Hello World” stage, the framework comes bundled with quite a lot of demos. However, these are nearly not documented at all, which can be very frustrating as a lot of the code in the demos handle presentation of data rather than actually sending data back and forth. This was far from clear, and I must say that I spent a bit more time learning how to set up subscriptions (TODO: Cross ref) than I had hoped for.

Another problem is the way the demos are organized. A normal Lightstreamer application would have one metadata adapter and one or more data adapters. Therefore, I expected each demo app to have its own metadata- and data adapter, but when debugging, methods in these were never called. It turned out that all the demo applications share a common metadata adapter class in which all the separate meta data adapters are gathered. A small text on the server start page is the only place where the common meta data adapter is mentioned (TODO: figure), and it was first after I discovered this that the learning process accelerated.

Finally, I missed some indications as to how a database normally would fit into a Lightstreamer application. There is no mention on how to do this in the documentation. In fact, the only mention I found of this was a question in the forum that had been answered, somewhat unclear in my opinion, by a Weswit employee (TODO: source). This may be due to the fact that the Lightstreamer server is supposed to be decoupled from everything except the real time aspects. Therefore, I do not regard this as a drawback with Lightstreamer, but there should perhaps have been some suggestion in the documentation on how a database would fit into the picture.

### Coding environment

### Code structuring

### Serialization

### Maturity

### Documentation

### Implementation of test application

### Testing

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## Play Framework

### Why I chose it

### How it works

### Getting started

### Coding environment

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## SignalR

### Why I chose it

### How it works

### Getting started

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## Meteor

### Why I chose it

### How it works

### Getting started

### Coding environment

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### Maturity

### Documentation

### Implementation of test application

### Testing

### Summary

## Conclusion

1. 0.7 preview was released May 5th 2011 [↑](#footnote-ref-1)
2. <https://trello.com/> [↑](#footnote-ref-2)
3. [www.stackoverflow.com](http://www.stackoverflow.com) [↑](#footnote-ref-3)
4. The fallback happens ”behind the scenes” so that developers do not need to worry about it. [↑](#footnote-ref-4)
5. The command ”npm install socket.io” installes socket.io and all dependencies right into your project.TODO: codelist instead of footnote? [↑](#footnote-ref-5)
6. If the server code is C# for instance, it is common to use Visual Studio also for the client side JavaScript code. [↑](#footnote-ref-6)
7. <http://www.sublimetext.com/> [↑](#footnote-ref-7)
8. [www.jetbrains.com](http://www.jetbrains.com) [↑](#footnote-ref-8)
9. This means that, by default, JavaScript code is non-blocking. You can, however, write synchronous code. [↑](#footnote-ref-9)
10. One might for instance put all database logic in one module. If this is a lot of logic, one can split the “main” database module into several, smaller modules, each with a more narrow responsibility. [↑](#footnote-ref-10)
11. When serializing a Date object to JSON, you actually just get the string representation of the object (toString). To deserialize this, one has to initialize a new Date object instance (TODO: js date node soruce). [↑](#footnote-ref-11)
12. Also known as deferred or futures. [↑](#footnote-ref-12)
13. Jasmine (<http://pivotal.github.io/jasmine/>) was another testing framework I considered, but it doesn’t seem to provide as good asynchronous testing as Mocha. [↑](#footnote-ref-13)
14. <http://forums.lightstreamer.com/forum.php> [↑](#footnote-ref-14)
15. See full list of features here: <http://www.lightstreamer.com/products> [↑](#footnote-ref-15)