

Six steps from zero to IDE

@olafurpg

[Watch this talk on YouTube](#)

“The Scala IDE situation is quite possibly the worst out of all the industrial languages in existence. They’re all terrible, especially VS Code or Atom. Just use IntelliJ and hope for the best.”

— r/scala, 10 points

Let's build an IDE!

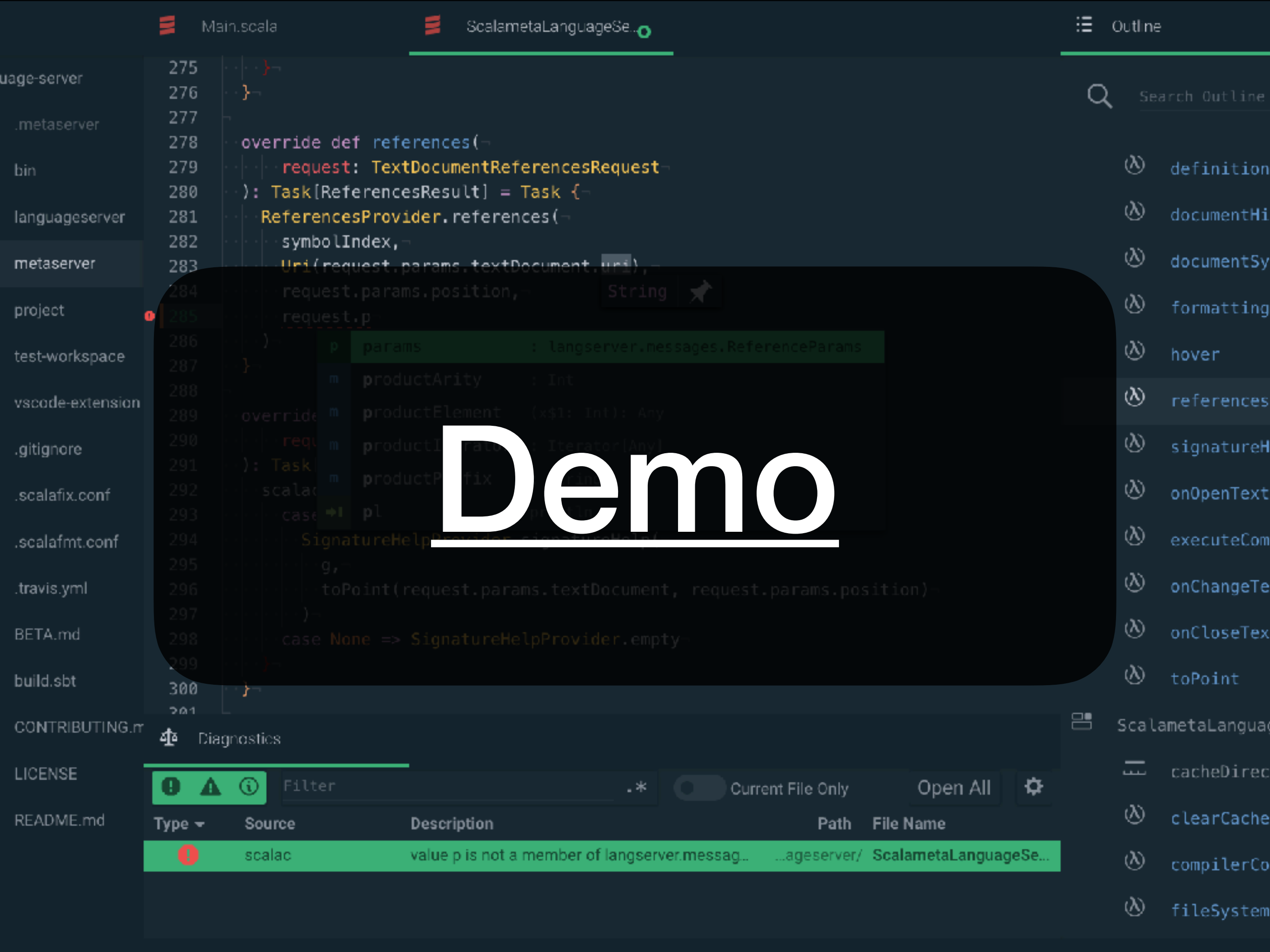
How hard can it be?

Pretty basic features

- Work with my editor
 - Vim, Sublime Text, VS Code, Atom, Emacs, ...
- Work with my build tool
 - sbt, gradle, maven, pants, bazel, mill, cbt, ...
- Diagnostics
 - No spurious red squiggles!

Pretty basic features

- Goto definition
 - Project sources, Scala deps, Java deps, classfiles
- Auto completions
 - Scope, auto-import, type members, extension methods
- Refactorings
 - Rename, organize imports, insert type annotation, ...



Demo



Filter

.*

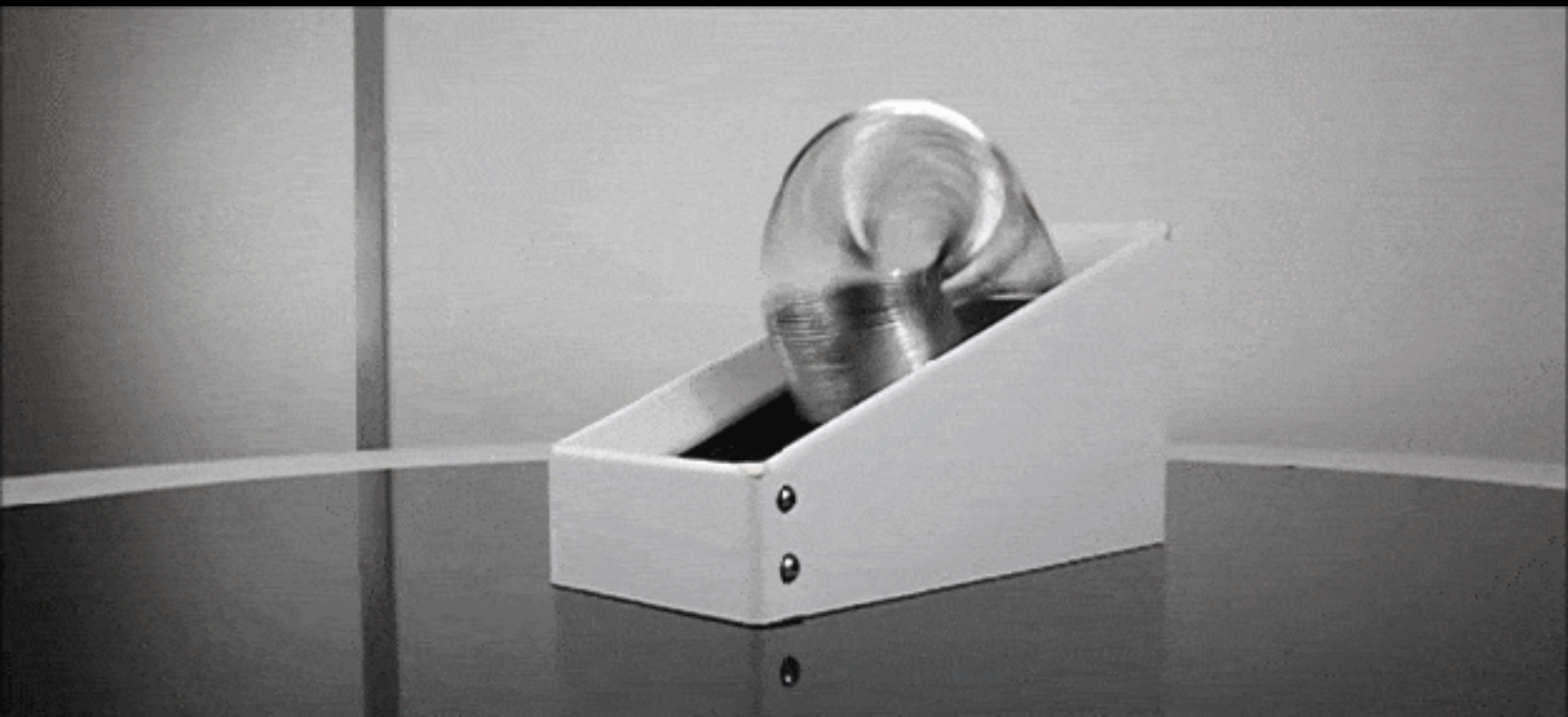


Current File Only


Open All



Type	Source	Description	Path	File Name
!	scalac	value p is not a member of langserver.messages	...ageserver/	ScalametaLanguageSe...



Rest of the talk

- Language Server Protocol
- “Zoo” of Scala language servers
- Build Server Protocol 
- Conclusion

	Scala	Java	Rust	Python
Vim				
Sublime				
VS Code				
Atom				
Emacs				
IntelliJ				

Language Server Protocol

Vim	✓
Sublime	✓
VS Code	✓
Atom	✓
Emacs	✓
IntelliJ	

Scala	✓
Java	✓
Rust	✓
Python	✓

*Developer Tool
(Host)*

*Language Server Protocol
(JSON-RPC)*

Language Server

Editor

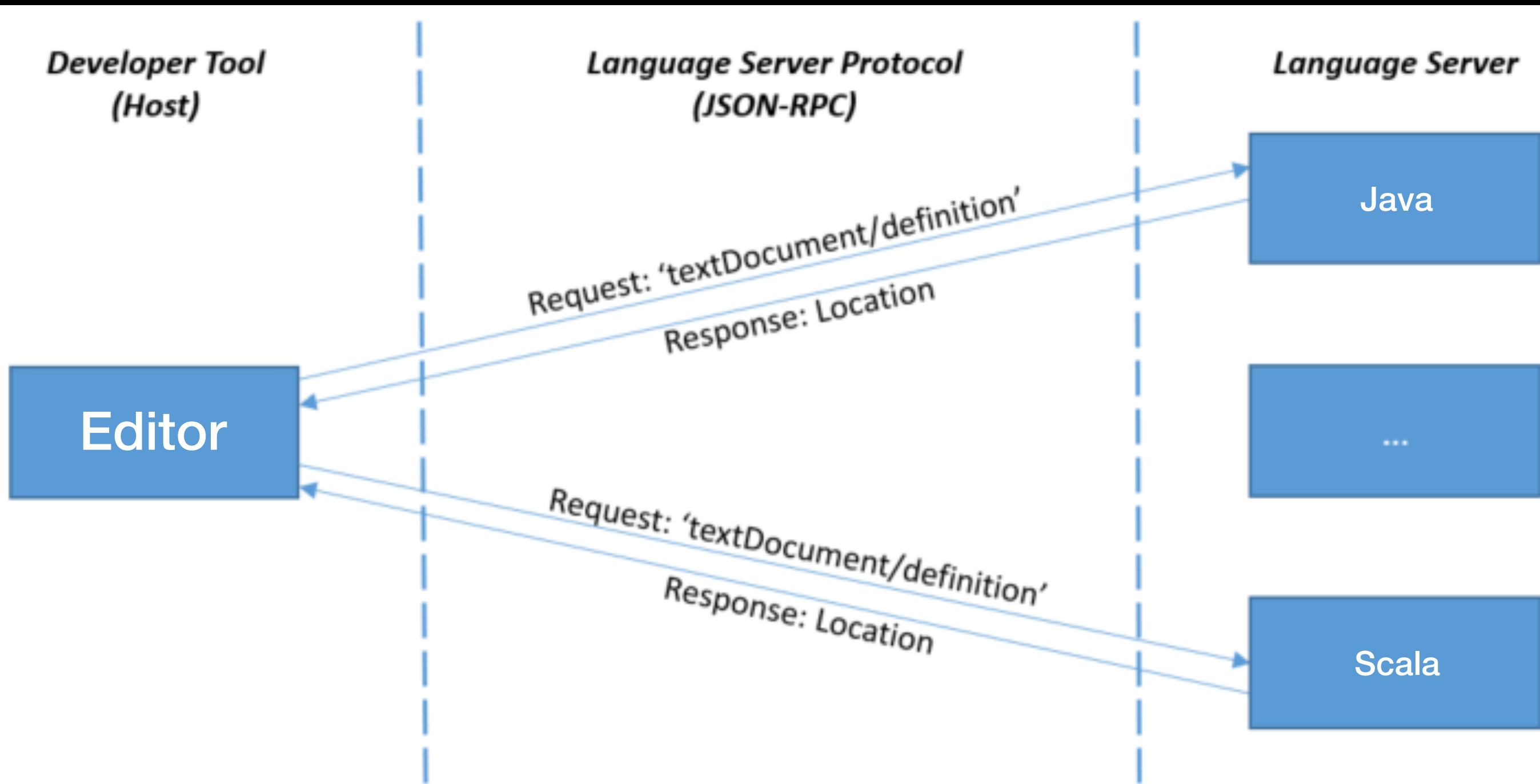
Java

...

Scala

Request: 'textDocument/definition'
Response: Location

Request: 'textDocument/definition'
Response: Location

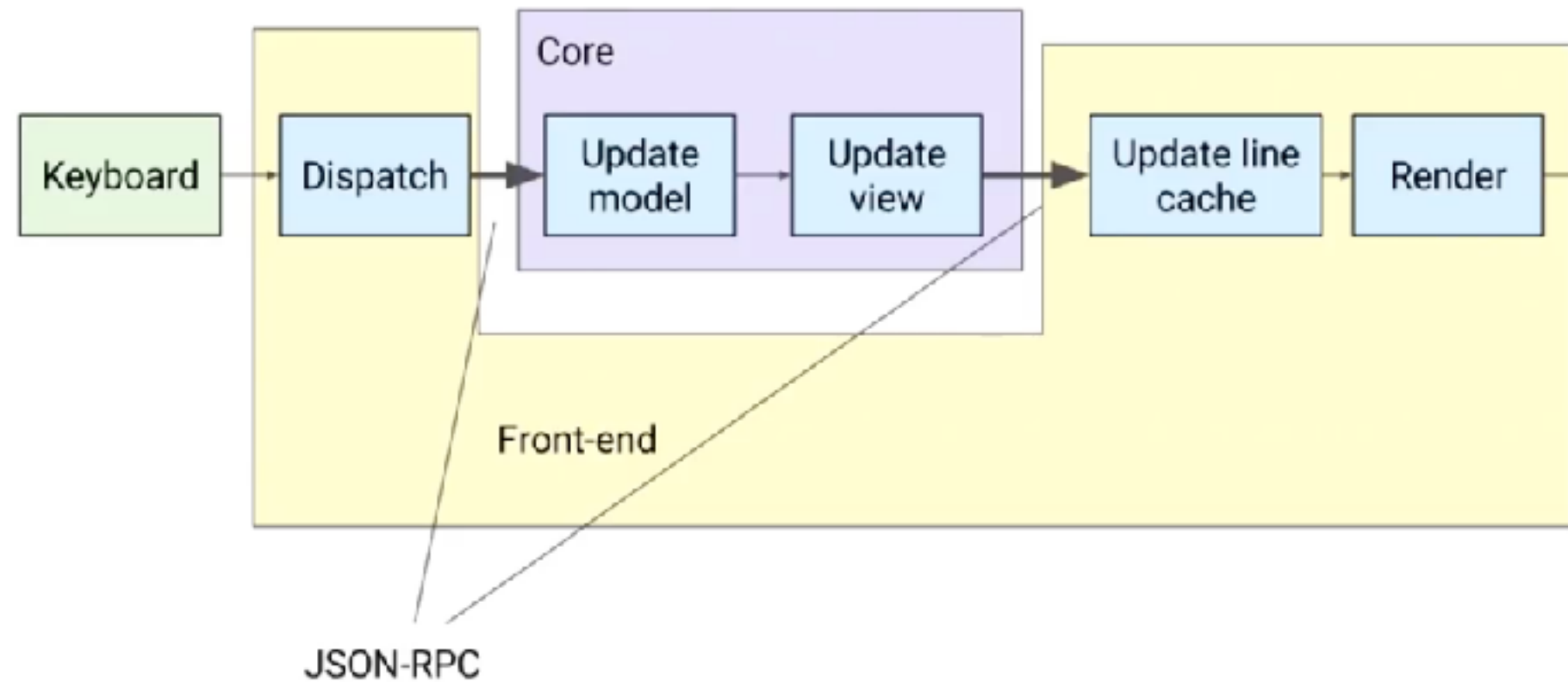


```
--> {"jsonrpc": "2.0", "method": "subtract", "params": [42, 23], "id": 1}  
<-- {"jsonrpc": "2.0", "result": 19, "id": 1}  
  
--> {"jsonrpc": "2.0", "method": "subtract", "params": [23, 42], "id": 2}  
<-- {"jsonrpc": "2.0", "result": -19, "id": 2}
```

JSON-RPC

Wait, JSON?
On every keystroke?

Editor as a pipeline

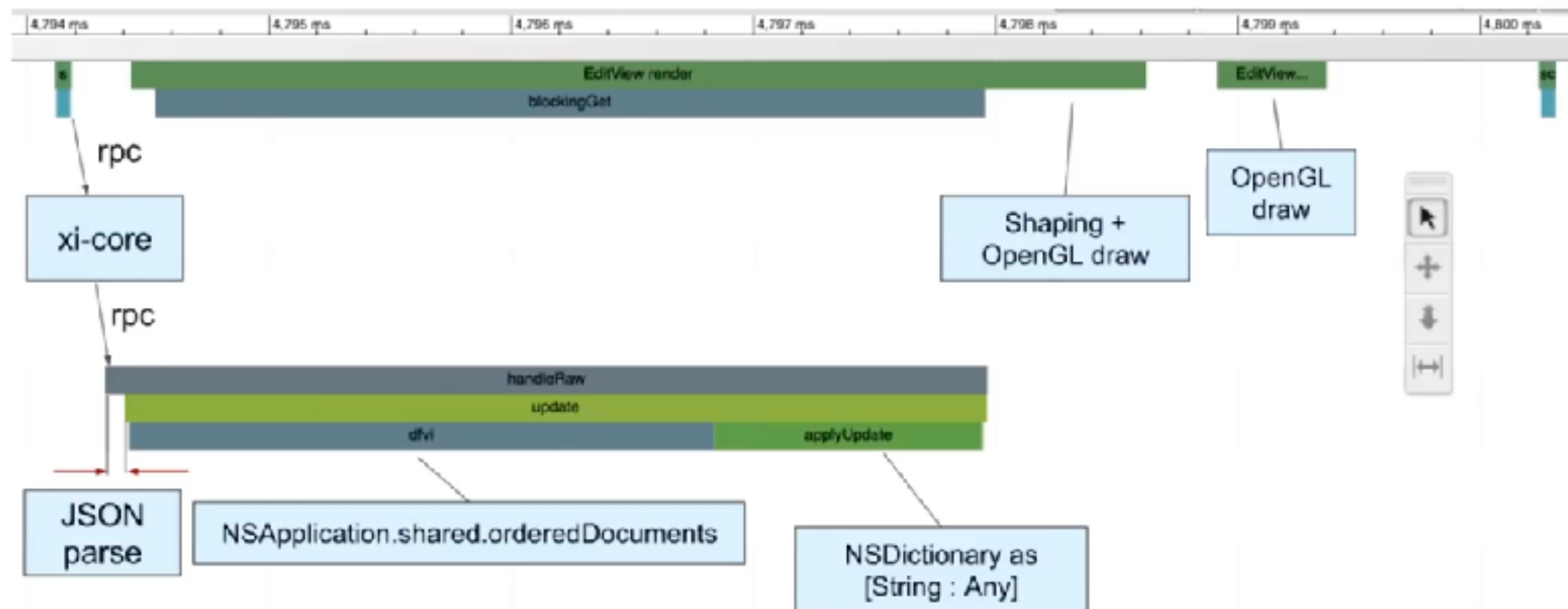


Xi

an editor for the next 20 years with with
uncompromising performance



Frame trace breakdown (scroll at 165Hz)



LGTM, where
do I sign up?



How to build an IDE

1.



1. Configure LSP

2.



2. Implement the rest of the IDE

Language Features

```
275 ...  
276 ...  
277 ...  
278 ... override def references(→  
279 ... request: TextDocumentReferencesRequest→  
280 ... ): Task[ReferencesResult] = Task {→  
281 ... ReferencesProvider.references(→  
282 ... symbolIndex,→  
283 ... Uri(request.params.textDocument.uri),→  
284 ... request.params.position,→  
285 ... request.p  
286 ... )  
287 ... }  
288 ...  
289 ... override  
290 ... requ  
291 ... ): Task  
292 ...  
293 ... case  
294 ... SignatureHelpProvider.signatureHelp(→  
295 ... 9,→  
296 ... toPoint(request.params.textDocument, request.params.position)→  
297 ... )→  
298 ... case None => SignatureHelpProvider.empty  
299 ...  
300 ...  
301 ...
```

String

params : langserver.messages.ReferenceParams

productArity : Int

productElement (x\$1: Int): Any

productIterator : Iterator[Any]

productIterator : Iterator[Any]

productIterator : Iterator[Any]

SignatureHelpProvider.signatureHelp(→

9,→

toPoint(request.params.textDocument, request.params.position)→

)→

case None => SignatureHelpProvider.empty

case None => SignatureHelpProvider.empty

Diagnostics



Filter

.*

Current File Only

Open All



Type

Source

Description

Path

File Name



scalac

value p is not a member of langserver.messages

...ageserver/ ScalametaLanguageSe...



Search Outline



definition



documentHi



documentSy



formatting



hover



references



signatureH



onOpenText



executeCom



onChangeTe



onCloseTex



toPoint



ScalametaLanguage



cacheDirec



clearCache



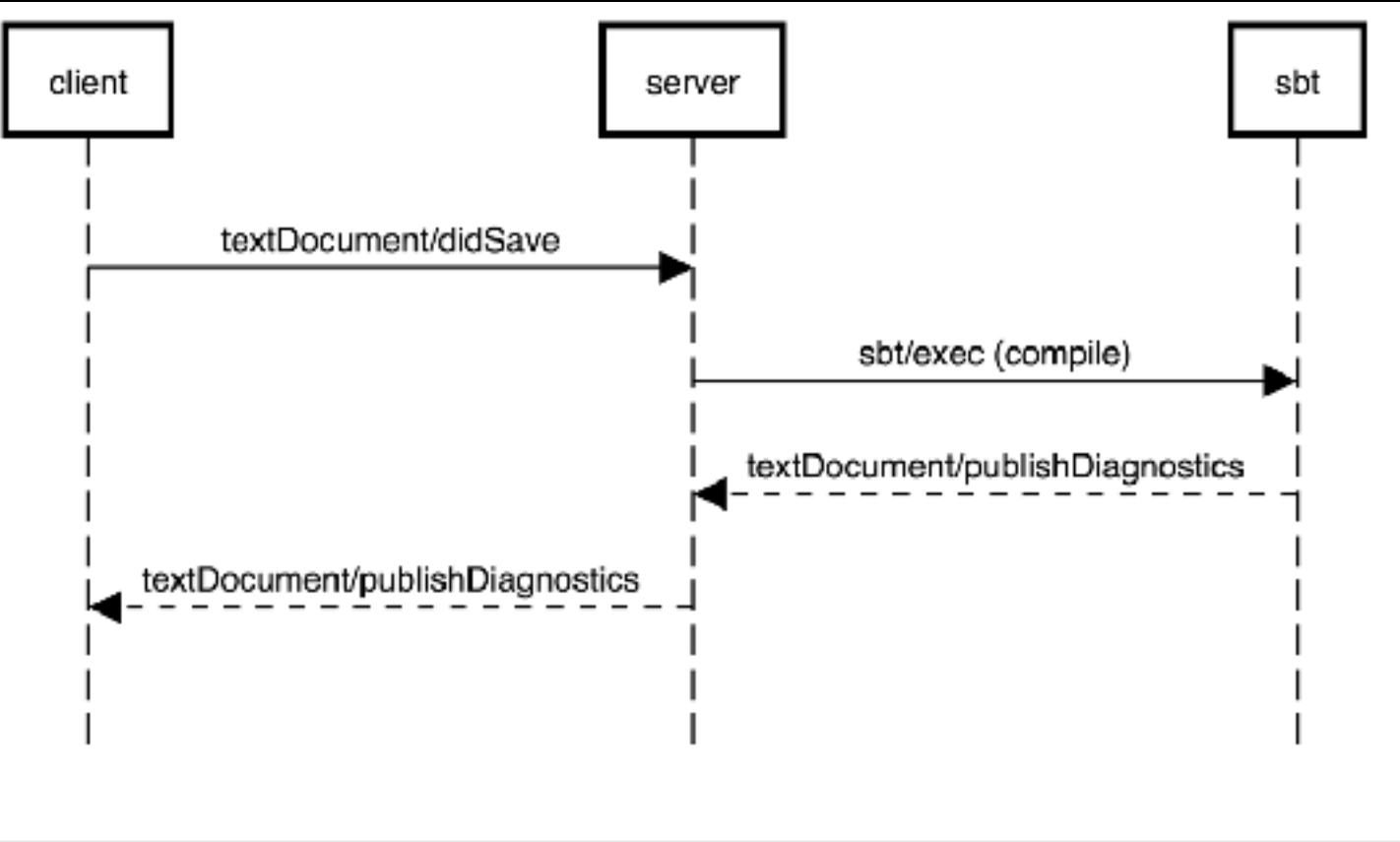
compilerCo



fileSystem



textDocument/publishDiagnostics

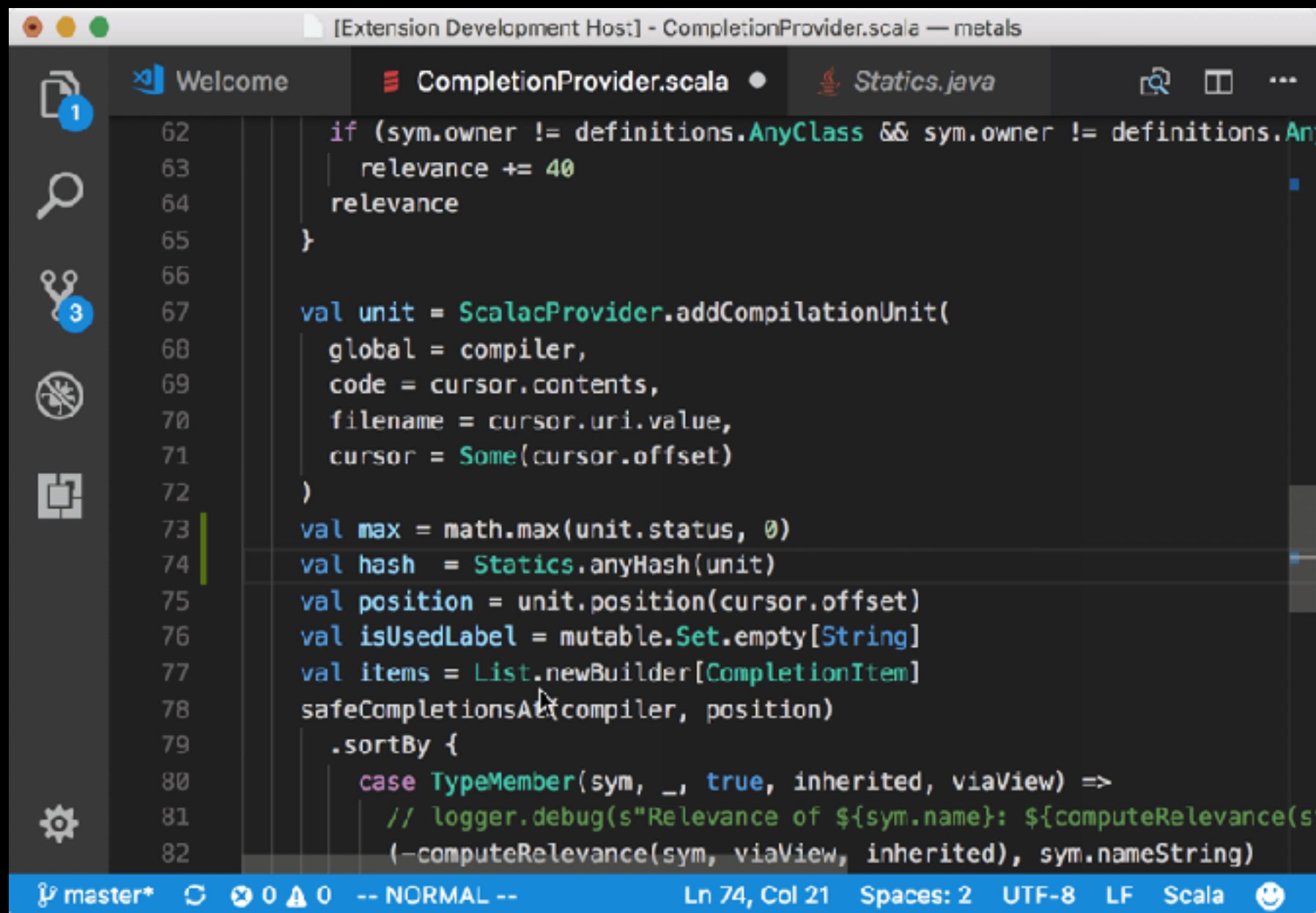


The screenshot shows the Visual Studio Code editor with the following details:

- Editor Tabs:** Welcome, A.scala x, User Settings, build.sbt.
- Code:**

```
1 package a
2
3 object A extends App {
4   def foo: String = {
5     "foo"
6   }
7 }
8
```
- PROBLEMS Panel:** Filter by type or text. No problems have been detected in the workspace so far.
- Status Bar:** 0 -- NORMAL MODE --, Ln 8, Col 1, Spaces: 2, UTF-8, LF, Scala.

textDocument/publishDiagnostics



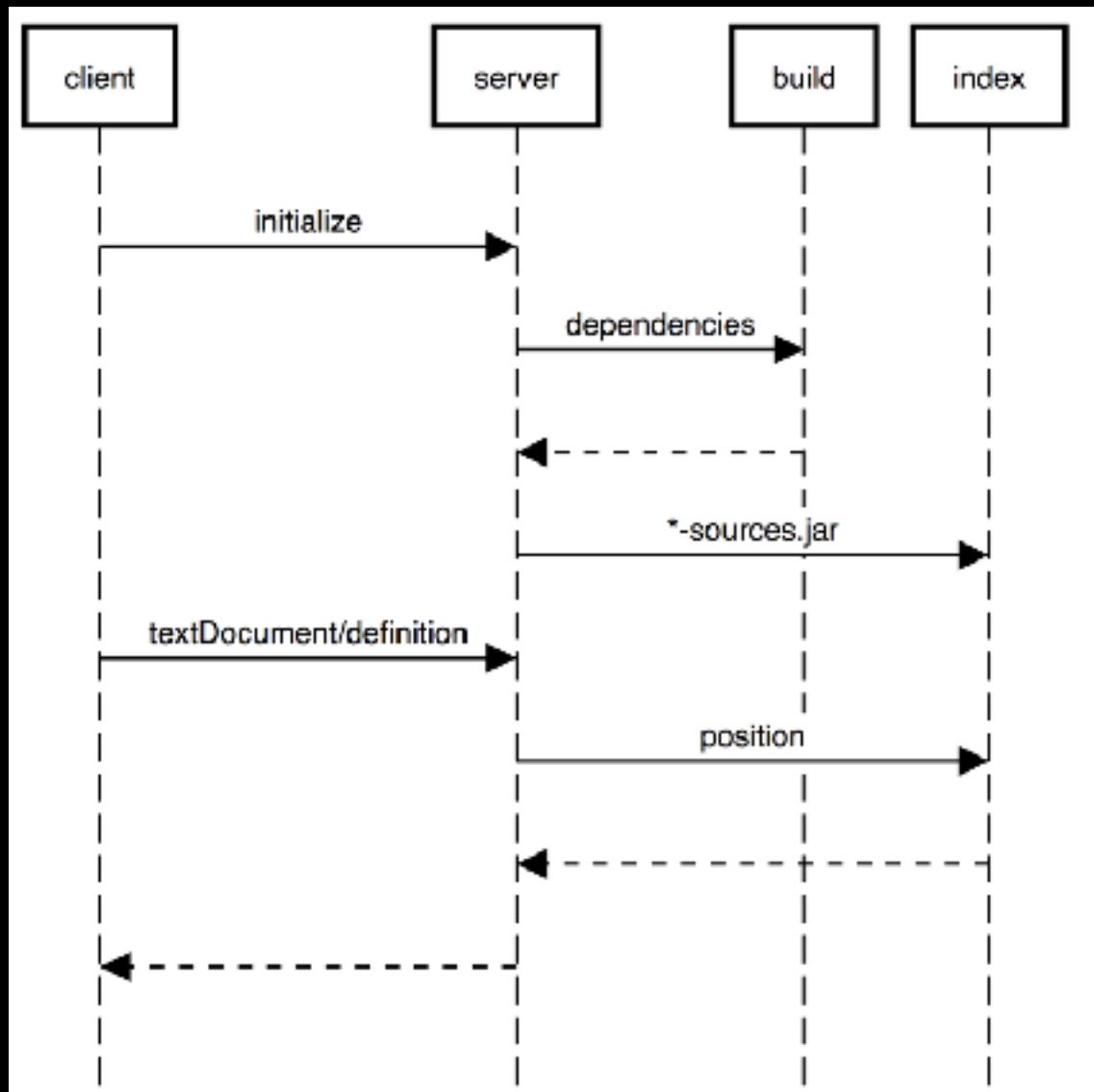
```
[Extension Development Host] - CompletionProvider.scala — metals

Welcome  CompletionProvider.scala  Statics.java

62     if (sym.owner != definitions.AnyClass && sym.owner != definitions.Any
63         | relevance += 40
64         | relevance
65     }
66
67     val unit = ScalacProvider.addCompilationUnit(
68         | global = compiler,
69         | code = cursor.contents,
70         | filename = cursor.uri.value,
71         | cursor = Some(cursor.offset)
72     )
73     val max = math.max(unit.status, 0)
74     val hash = Statics.anyHash(unit)
75     val position = unit.position(cursor.offset)
76     val isUsedLabel = mutable.Set.empty[String]
77     val items = List.newBuilder[CompletionItem]
78     safeCompletionsAt(compiler, position)
79     .sortBy {
80         | case TypeMember(sym, _, true, inherited, viaView) =>
81         | // logger.debug(s"Relevance of ${sym.name}: ${computeRelevance(s
82         | (-computeRelevance(sym, viaView, inherited), sym.nameString)
```

master* 0 0 -- NORMAL -- Ln 74, Col 21 Spaces: 2 UTF-8 LF Scala

textDocument/definition



The screenshot shows the IntelliJ IDEA editor with the file 'CompletionProvider.scala' open. The code is in Scala and shows a method that calculates the relevance of completion items. The code is as follows:

```
62 if (sym.owner != definitions.AnyClass && sym.owner != definitions.AnyClass)
63   relevance += 40
64   relevance
65 }
66
67 val unit = ScalacProvider.addCompilationUnit(
68   global = compiler,
69   code = cursor.contents,
70   filename = cursor.uri.value,
71   cursor = Some(cursor.offset)
72 )
73
74 val max = math.max(unit.status, 0)
75 val hash = Statics.anyHash(unit)
76 val position = unit.position(cursor.offset)
77 val isUsedLabel = mutable.Set.empty[String]
78 val items = List.newBuilder[CompletionItem]
79 safeCompletionsAt(compiler, position)
80   .sortBy {
81     case TypeMember(sym, _, true, inherited, viaView) =>
82       // logger.debug(s"Relevance of ${sym.name}: ${computeRelevance(s
83         (-computeRelevance(sym, viaView, inherited), sym.nameString)
```

textDocument/definition

SemanticDB

```
1 package spire.math
2
3 @SerialVersionUID(0L)
4 final case class Complex[@sp(Float, Double) T](real: T, imag:
5     T) extends ScalaNumber
6     with ScalaNumericConversions
7     with Serializable { lhs =>
8
9     def +(rhs: T)(implicit r: Semiring[T]): Complex[T] =
10         new Complex(real + rhs, imag)
11     def -(rhs: T)(implicit r: Rng[T]): Complex[T] =
12         new Complex(real - rhs, imag)
13     def *(rhs: T)(implicit r: Semiring[T]): Complex[T] =
14         new Complex(real * rhs, imag * rhs)
15     def /(rhs: T)(implicit r: Field[T]): Complex[T] =
16         new Complex(real / rhs, imag / rhs)
17
18 }
```

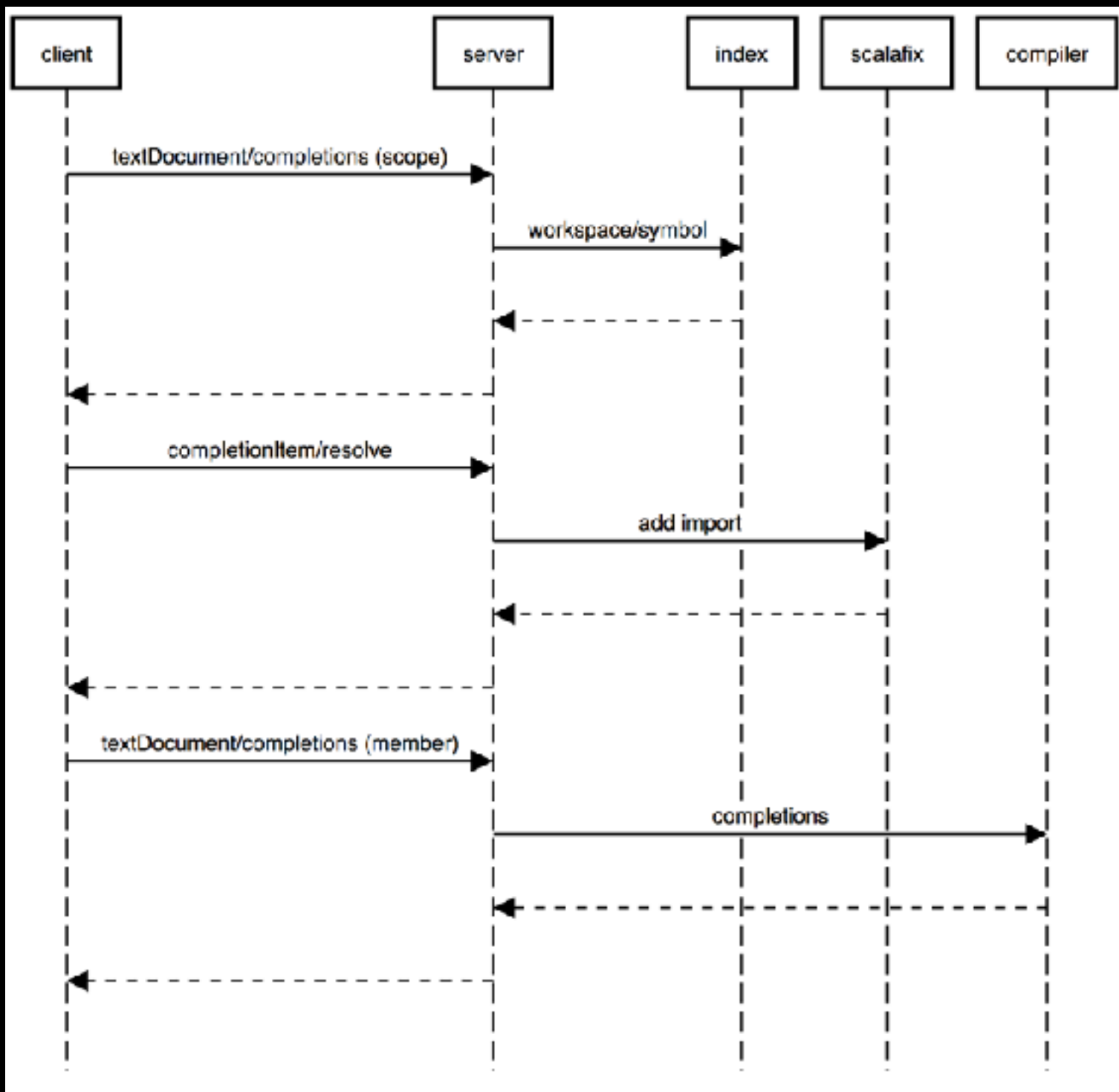
Symbol: spire.math.Complex#real().
Range: 10:18-10:22
Role: REFERENCE



The image shows a screenshot of a Scala IDE with two tabs: Buffers.scala and Parser.scala. The Buffers.scala tab is active, displaying the following code:

```
1 package scala.meta.languageserver
2
3 import scala.meta._
4
5 object Main extends App {
6
7     val code = "object Code".parse[Source]
8
9 }
10
11
12
```

textDocument/completions



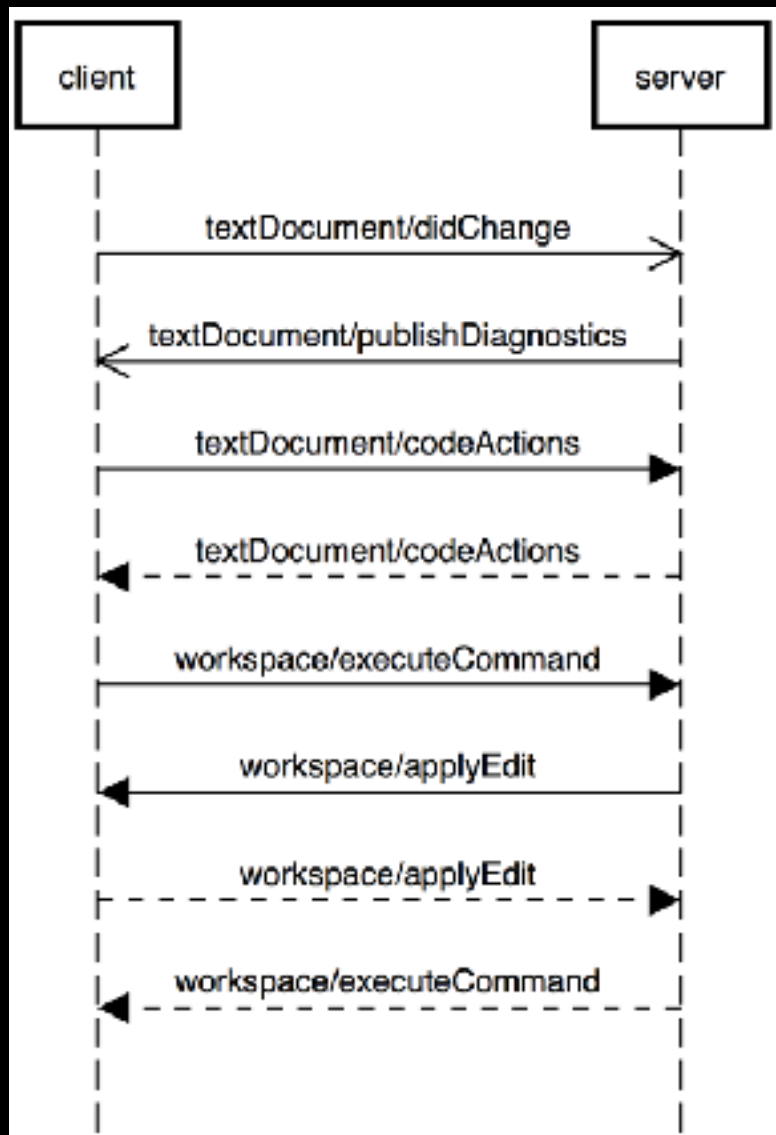
```
Buffers.scala  Parser.scala
1 package scala.meta.languageserver
2
3 import scala.meta._
4
5 object Main extends App {
6
7   val code = "object Code".parse[Source]
8
9 }
10
11
12
```

textDocument/completions

```
Semanticdbs.scala x HotBaseProtocolMessageParserBench.scala

14 import com.typesafe.scalalogging.LazyLogging
15 import org.langmeta.inputs.Input
16 import org.langmeta.internal.semanticdb.schema.Database
17 import org.langmeta.io.AbsolutePath
18 import com.sun.crypto.provider.AESKeyGenerator
19 import scala.concurrent.{Future, Await, Awaitable => Danger}
20
21 object Semanticdbs extends LazyLogging {
22   Future.successful(1)
23
24   def toSemanticdb(
25     input: Input.VirtualFile,
26     scalacProvider: ScalacProvider
27   ): Option[semanticdb.Database] =
```

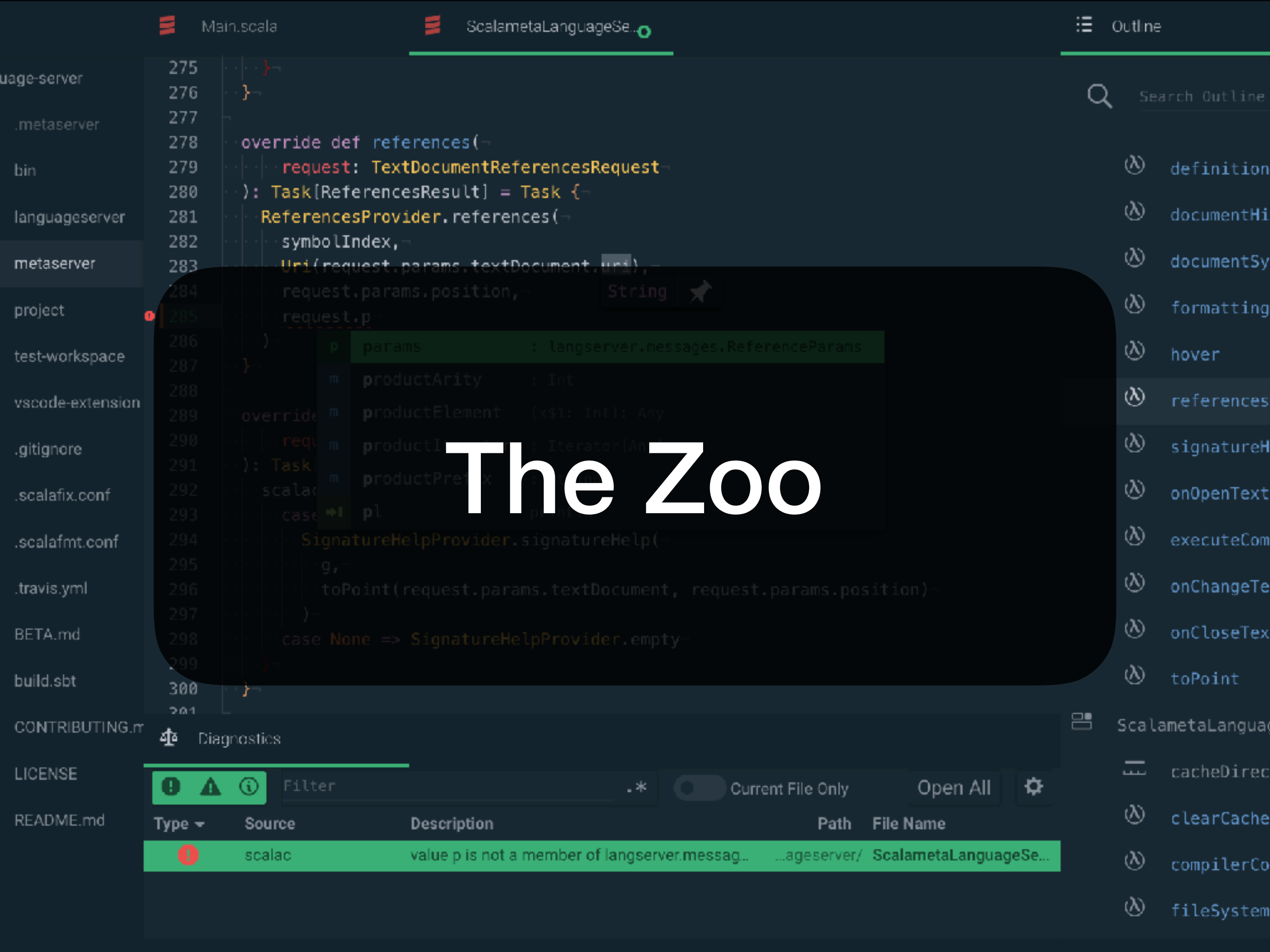
textDocument/codeActions



```
Semanticdbs.scala x HotBaseProtocolMessageParserBench.scala
14 import com.typesafe.scalalogging.LazyLogging
15 import org.langmeta.inputs.Input
16 import org.langmeta.internal.semanticdb.schema.Database
17 import org.langmeta.io.AbsolutePath
18 import com.sun.crypto.provider.AESKeyGenerator
19 import scala.concurrent.{Future, Await, Awaitable => Danger}
20
21 object Semanticdbs extends LazyLogging {
22   Future.successful(1)
23
24   def toSemanticdb(
25     input: Input.VirtualFile,
26     scalacProvider: ScalacProvider
27   ): Option[semanticdb.Database] =
```

textDocument/codeActions





The Zoo

	ENSIME	Dotty	sbt	Metals
Navigation	Graphpocolypse	TASTY*	zinc analyses*	SemanticDB
Diagnostics	scalac	dotc	sbt server	sbt server/scalac
Completions	scalac	dotc		scalac
Refactoring	scala-refactoring			scalafix

*partial support



Main.scala



ScalametaLanguageSe...



Outline



Search Outline

uage-server

.metaserver

bin

languageserver

metaserver

project

test-workspace

vscode-extension

.gitignore

.scalafix.conf

.scalafmt.conf

.travis.yml

BETA.md

build.sbt

CONTRIBUTING.m

LICENSE

README.md

```
275 ... }
276 ... }
277
278 ... override def references(
279 ...   request: TextDocumentReferencesRequest
280 ... ): Task[ReferencesResult] = Task {
281 ...   ReferencesProvider.references(
282 ...     symbolIndex,
283 ...     Uri(request.params.textDocument.uri),
284 ...     request.params.position,
285 ...     request.p
286 ...   )
287 ... }
288
289 ... override
290 ...   request
291 ... ): Task
292 ...   scalac
293 ...   case
294 ...   SignatureHelpProvider.signatureHelp(
295 ...     9,
296 ...     toPoint(request.params.textDocument, request.params.position)
297 ...   )
298 ...   case None => SignatureHelpProvider.empty
299 ... }
300 ... }
301 ... }
```

String



Limitations

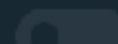


Diagnostics



Filter

.*



Current File Only

Open All



Type	Source	Description	Path	File Name
	scalac	value p is not a member of langserver.messag...	...ageserver/	ScalametaLanguageSe...



ScalametaLanguageSe...



cachedirecto...



clearCache



compilerCo



fileSystem

Pretty Basic Features

- Work with my build tool
 - sbt, gradle, maven, pants, bazel, mill, cbt, ...

	IntelliJ	ENSIME	Dotty	Metals
sbt	✓	✓	✓	✓
maven	✓	✓		
gradle	✓	✓		
pants	✓	✓		
bazel	✓			
mill	✓			
bloop	✓			

Build Server Protocol



sbt	
maven	
gradle	
pants	
bazel	
mill	
bloop	

IntelliJ	
ENSIME	
Dotty	
Metals	



Build Server Protocol and fresh IDEAs

— @ebenwert, @jvican at ScalaSphere April 2018

Conclusion

- Work with my editor
- Work with my build tool
- Diagnostics
- Navigation
- Completions
- Refactoring

Conclusion

- ~~Work with my editor~~ → LSP!
- Work with my build tool
- Diagnostics
- Navigation
- Completions
- Refactoring

Conclusion

- ~~Work with my editor~~ → LSP!
- ~~Work with my build tool~~ → BSP!
- ~~Diagnostics~~ → BSP+LSP!
- Navigation
- Completions
- Refactoring

Conclusion

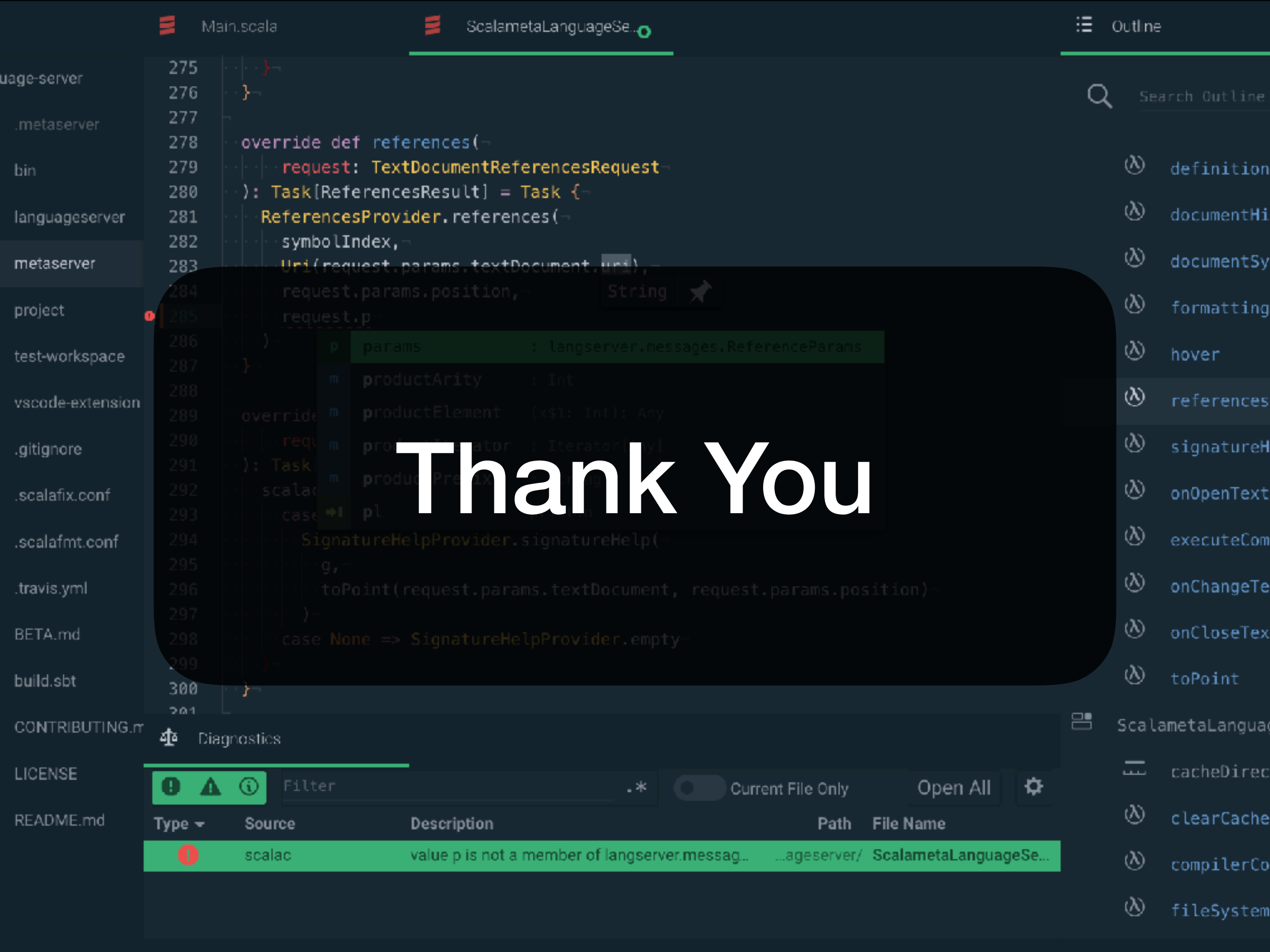
- ~~Work with my editor~~ → LSP!
- ~~Work with my build tool~~ → BSP!
- Diagnostics → BSP+LSP!
- Navigation → SemanticDB!
- Completions
- Refactoring

Conclusion

- ~~Work with my editor~~ → LSP!
- ~~Work with my build tool~~ → BSP!
- Diagnostics → BSP+LSP!
- Navigation → SemanticDB!
- Completions → ???!
- Refactoring

Conclusion

- ~~Work with my editor~~ → LSP!
- ~~Work with my build tool~~ → BSP!
- Diagnostics → BSP+LSP!
- Navigation → SemanticDB!
- Completions → ???!
- Refactoring → Scalafix!



Thank You



Filter

.*



Current File Only

Open All



Type	Source	Description	Path	File Name
	scalac	value p is not a member of langserver.messages...	...ageserver/	ScalametaLanguageSe...