# Build Server Protocol and new IDEAs

## Justin @ebenwert

- Build tools engineer at Jetbrains
  - I work on the IntelliJ sbt integration
  - I believe in tools before rules
- **Obsession**: build tools complaints in Gitter

## Jorge @jvican

- Devtools for ~2.5 years at Scala Center
  - I co-maintain Scala's incremental compiler (Zinc)
  - I work on build tools and build servers
  - `scalac`, compiler plugins and infrastructure
- **Obsession**: developer productivity

## Agenda

1. The BSP IDEA
2. The BSP protocol
3. The BSP integrations

## Goal

1. Explain why BSP solves a real problem
2. Share our findings with the audience

## How BSP came up

...

## Use case (I)

*Language servers*

ENSIME

eclipse

# Use case (II)

*Editors*

# Build tools

## As the ultimate source of truth

<APACHE ANT>

Gradle

Buck

sbt

maven

# 100 combinations!

**BSP** (Build Server Protocol) is an attempt to formalize the communication between **language server/editors** and **build tools**.

*«**LSP** creates the opportunity to reduce the m-times-n complexity problem of providing a high level of support for **any programming language** in any editor, IDE, or client endpoint to a simpler m-plus-n problem.»*

*-- https://langserver.org/*

*«**BSP** creates the opportunity to reduce the m-times-n complexity problem of providing a high level of support for **any build tool** in any editor, IDE, or client endpoint to a simpler m-plus-n problem.»*

*-- Justin and Jorge*

*«Bejeezus, I just want bloody fast and correct compiles for my team.»*

*-- Sam Halliday, serious devtools engineer*

## Developer productivity engineers

**want solutions that are**

1. Extensible
2. Easy to maintain
3. And ideally
    1. Build tool independent
    2. Editor independent

```diff
--- a/nothing.properties
+++ b/bsp.properties
- build.tool.specific=true
- one.time.effort=false
- shared.code=false
- robust=false
- easier.to.maintain=false
- easier.to.test=false
+ build.tool.specific=false
+ one.time.effort=true
+ shared.code=true
+ robust=true
+ easier.to.maintain=true
+ easier.to.test=true
```

## BSP Protocol

# Fundamentals I

1. JSON-RPC-based protocol
2. It has the notion of
    - Request/Response
    - Bidirectional notifications

## Fundamentals II

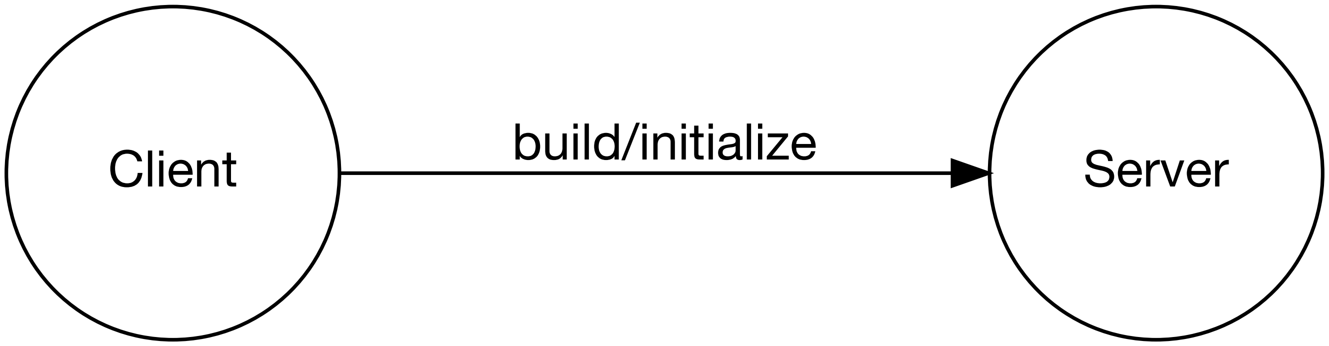
1. Modelled after LSP
    - Specification follows same format
    - Client-driven design
    - It reuses some LSP methods, e.g.
        - `window/logMessage`
        - `textDocument/publishDiagnostics`
        - `$/cancelRequest`
2. Aims to be implementable alongisde LSP

## Server lifetime

- Firing up BSP server
  - `stdin/stdout`
  - TCP/UDP connections.
  - Unix Sockets/Windows pipes
- Initializing BSP connection
  - Similar to TCP 3-way handshake
- Shutting down the BSP server

# Server lifetime

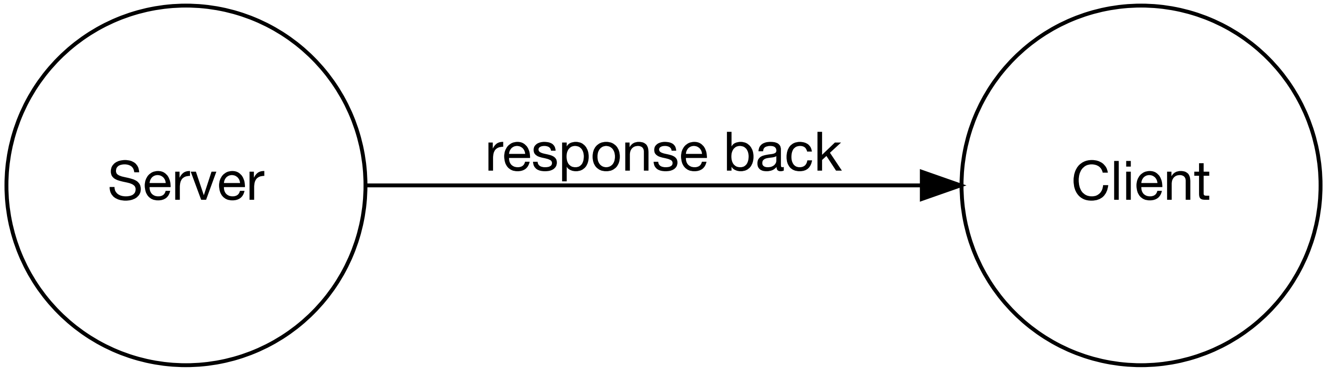
*Request*



```
trait InitializeBuildParams {
  def rootUri: URI
  def capabilities: BuildClientCapabilities
}
trait BuildClientCapabilities {
    def languageIds: List[String]
}
```

# Server lifetime

*Response*

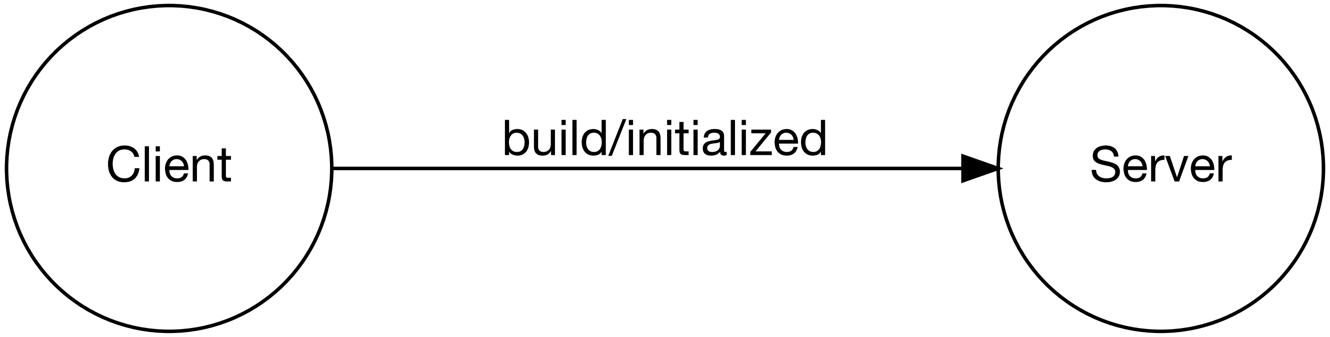


```
trait InitializeBuildResult {
  capabilities: BuildServerCapabilities
}

trait BuildServerCapabilities {
  compileProvider: Boolean
  testProvider: Boolean
  textDocumentBuildTargetsProvider: Boolean
  dependencySourcesProvider: Boolean
  buildTargetChangedProvider: Boolean
}
```

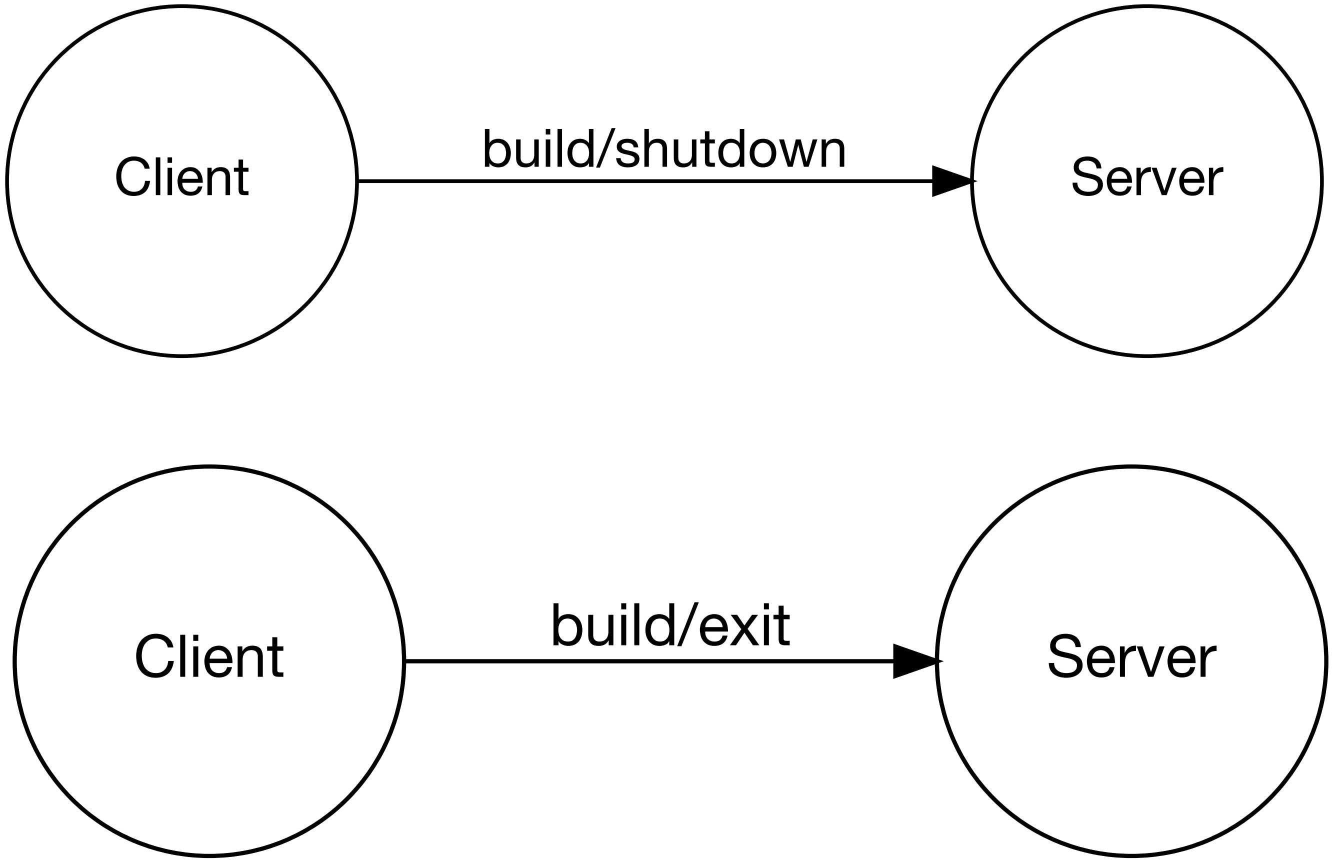
## Server lifetime

*Notification*



```
trait InitializedBuildParams {}
```

# Server lifetime



## Core data structure

A common notion of what a target is
across different build tools and language servers

```
trait BuildTarget {
  def id: BuildTargetIdentifier
  def displayName: Option[String]
  def languageIds: List[String]
  def data: Option[Json]
}

trait URI { def uri: String }
trait BuildTargetIdentifier {
  def uri: URI
}
```

$$\begin{tikzcd}\boxed{\text{Build tool module}} \arrow[r] & \boxed{\text{Build target}} \arrow[r] & \boxed{\text{IDE module}}\end{tikzcd}$$

# workspace/buildTargets

## Client => Server

```
trait WorkspaceBuildTargetsParams {}
```

## Server => Client

```
trait WorkspaceBuildTargetsResult {
  def targets: List[BuildTarget]
}
```

# buildTarget/dependencySources

## Client => Server

```scala
trait DependencySourcesParams {
  def targets: List[BuildTargetIdentifier]
}
```

## Server => Client

```scala
trait DependencySourcesResult {
  def items: List[DependencySourcesItem]
}
trait DependencySourcesItem {
  def target: BuildTargetIdentifier
  def sources: List[URI]
}
```

## buildTarget/compile

### Client => Server

```scala
trait CompileParams {
  def targets: List[BuildTargetIdentifier]
  def arguments: List[Json]
}
```

### Server => Client

```scala
trait CompileReport {
  def items: List[CompileReportItem]
}
trait CompileReportItem {
  def target: BuildTargetIdentifier
  def errors: Long
  def warnings: Long
  def time: Option[Long]
  def linesOfCode: Option[Long]
}
```

## buildTarget/test

### Client => Server

```
trait TestParams {
  def targets: List[BuildTargetIdentifier]
  def arguments: List[Json]
}
```

### Server => Client

```
trait TestReport {
  def items: List[TestReportItem]
}
trait TestReportItem {
  def target: BuildTargetIdentifier
  def compileReport: Option[CompileReportItem]
  def passed: Long
  def failed: Long
  def ignored: Long
  def time: Option[Long]
}
```

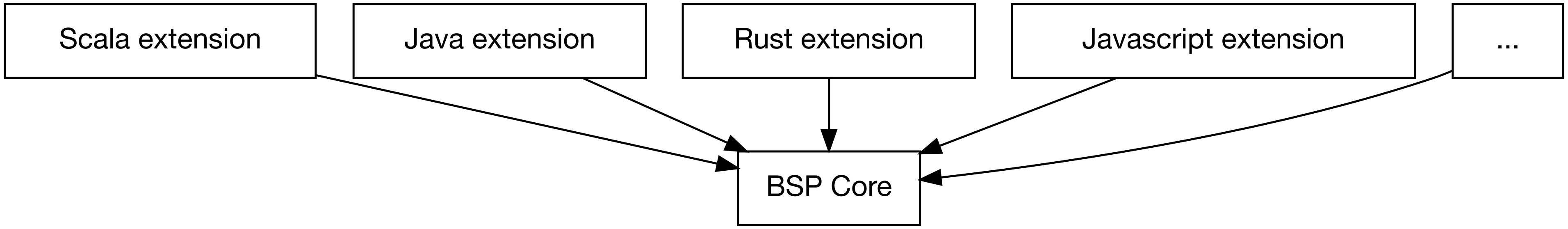
# Other BSP methods

Not covered in this presentation,
but present in the spec.

- `buildTarget/didChange`
- `buildTarget/dependencyResources`
- `buildTarget/textDocuments`
- `textDocument/buildTargets`

So... is BSP language agnostic?

**Yes!**



# Meet language extensions

Extensions formalize language-specific metadata, like:

- Which standard library to use.
- Which platform a language runs on.
- Which compilation flags are enabled.

## Scala extension

```scala
trait ScalaBuildTarget {
  def scalaOrganization: String
  def scalaCompiler: String
  def scalaVersion: String
  def scalaBinaryVersion: String
  def platform: ScalaPlatform
}

object ScalaPlatform {
  val JVM = 1
  val JS = 2
  val Native = 3
}
```

# buildTarget/scalacOptions

## Client => Server

```
trait ScalacOptionsParams {
  def targets: List[BuildTargetIdentifier]
}
```

## Server => Client

```
trait ScalacOptionsResult {
  def items: List[ScalcOptionItem]
}

trait ScalacOptionsItem {
    def target: BuildTargetIdentifier
    def options: List[String]
    def classpath: List[String]
    def classDirectory: String
}
```

# buildTarget/scalaTestClasses

## Client => Server

```
trait ScalaTestClassesParams {
  def targets: List[BuildTargetIdentifier]
}
```

## Server => Client

```
trait ScalaTestClassesResult {
  def items: List[ScalaTestClassesItem]
}
trait ScalaTestClassesItem {
    def target: BuildTargetIdentifier
    def classes: List[String]
}
```

## On the roadmap

- Add BSP method for file watching.
- Add compile progress notifications.
- Add BSP `buildTarget/run`.
- Enable remote compilation.
    - How do we handle repository state?
        - Pass in diffs like LSP does.
        - Relay repo synchronization to third-party.

# On the roadmap

- On the lookout for feedback
  - scalacenter/bsp
- Formal proposal to STP-WG
- Scala/Scala.js-based client integrations:
  - `vim`
  - `vscode`
  - `sublime/atom`

## IntelliJ integration

# Thanks.

- Do you want to learn more?
  - Come talk to us!
  - Help improve the spec in scalacenter/bsp
- Chat on Bloop's Gitter.
- Chat on intellij-scala's Gitter.