Projector: Your Remote IDE

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Did you ever complain?

- You need to set up a VPN to access data?
- You need to use RDP to access your instance of IDEA?
- Or even VNC?
- *Long* indexing?
- Huge project compiles forever?

Did you ever want?

- Edit code from tablet/smartphone?
- Help your colleague to fix some issues?
- Show demo which accesses data from your cloud?
- Work from a weak laptop?


PJ

Issues with existing solutions. VPN

1. OpenVPN does not scale
    1. No central identity management
    2. No failover OOTB
2. Proprietary solutions are… proprietary
3. And expensive sometimes
4. IKE is not completely cross-platform

Issues with existing solutions. VNC

1. **Extremely** slow
2. Complex infrastructure (VPN?)

Issues with existing solutions. RDP

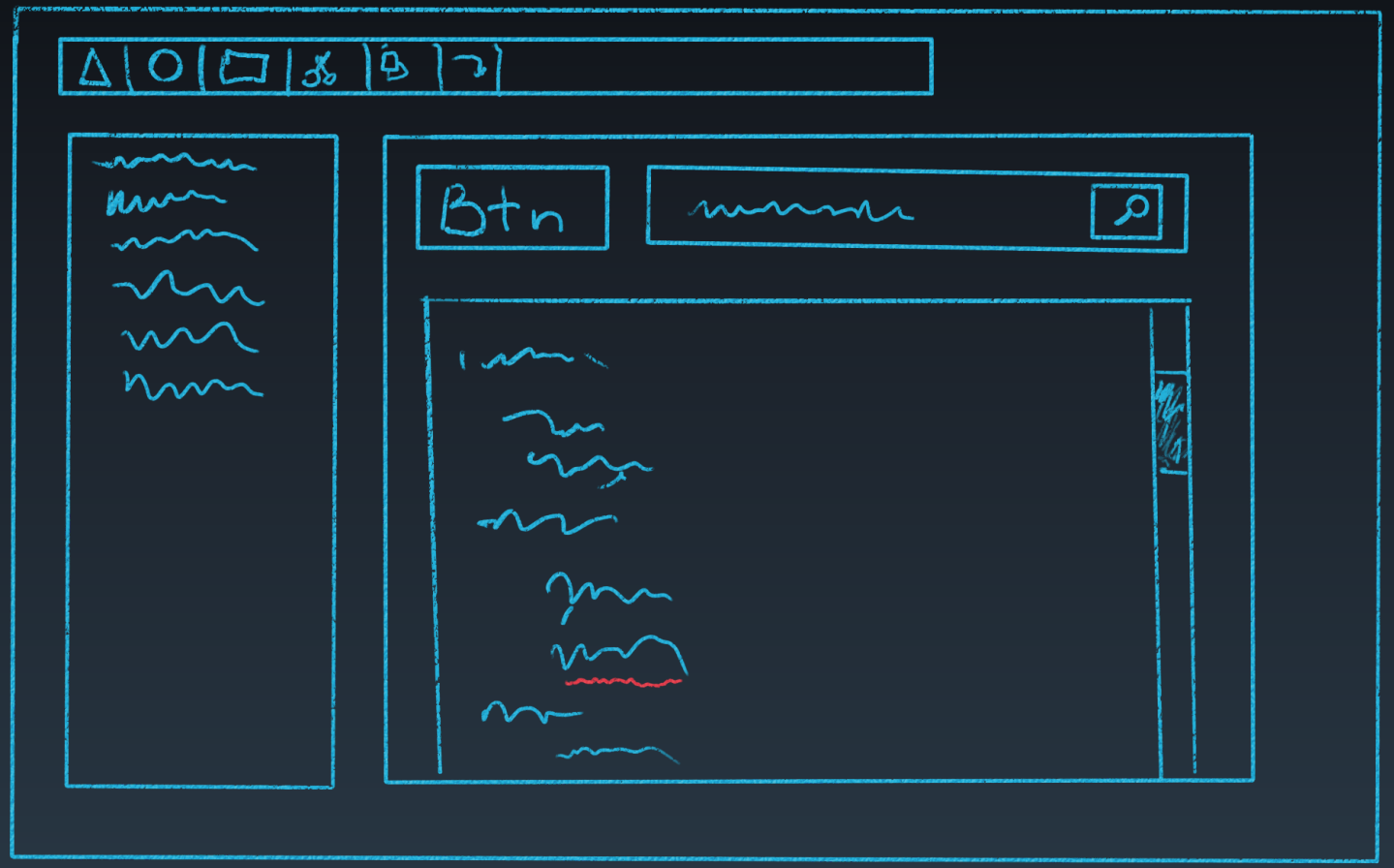
RDP is awesome

1. Single-user
2. Requires special client
3. Still needs complex infrastructure to provide access

Stop this

Let's dig!

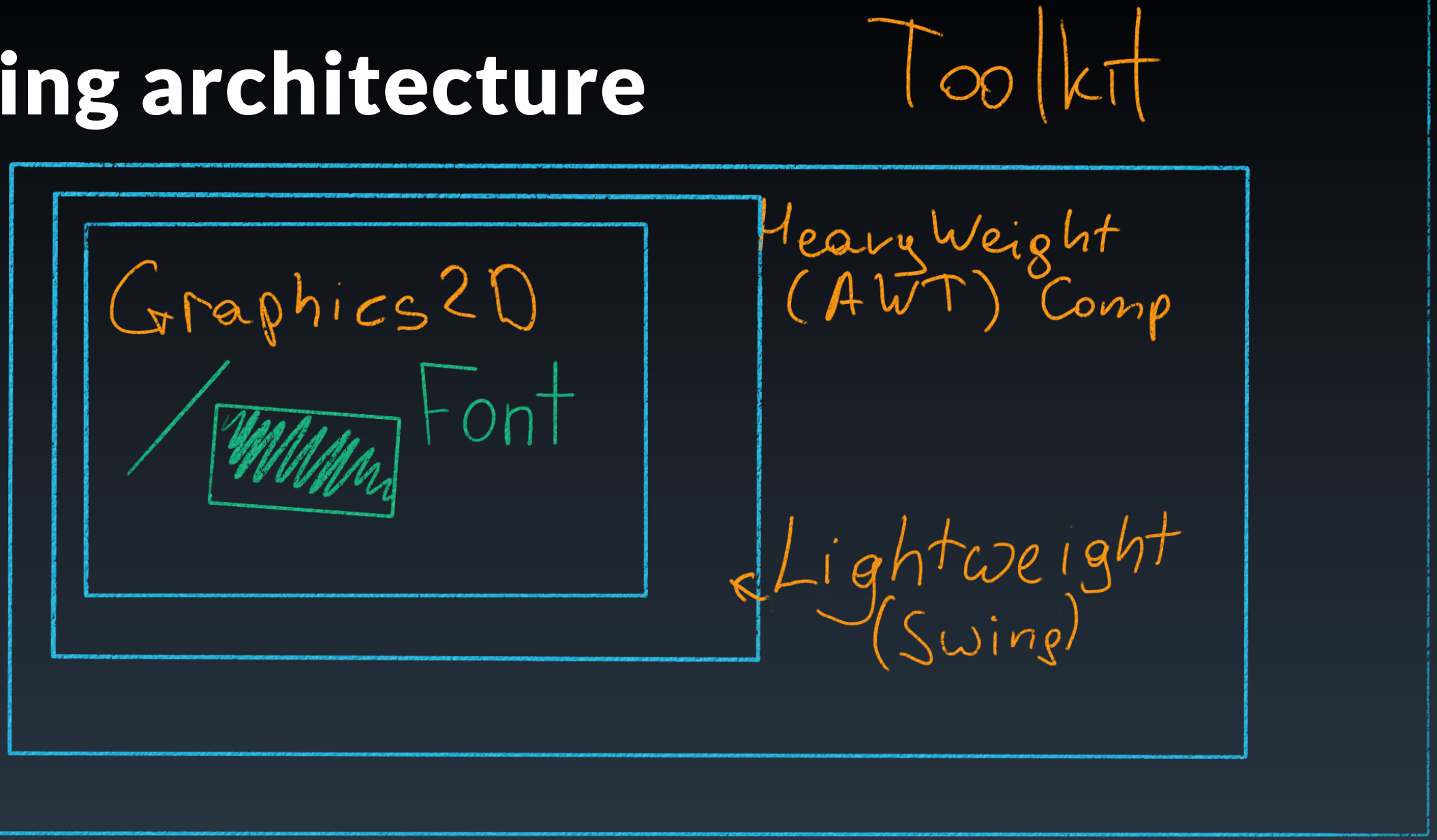
Typical Swing interface



And in reality?

- Lines
- Simple shapes
- Strings
- Fonts

Swing architecture



Definitions

Toolkit — abstraction over the whole graphics
Heavyweight components — system-controlled components
Lightweight components — user-controlled components
Graphics2D — drawing controller

Types of drawing surfaces

- Visible
- Invisible
  Part of the editor, which you don't see, is separate and is drawn on an invisible surface.

Each window has its surface(s)

Heavyweight components

There is a corresponding `Peer` class for each heavyweight component.

```
interface ComponentPeer {
    void paint(Graphics g);
    void setBounds(int x, int y, int width, int height, int op);
    void handleEvent(AWTEvent e);
    void setBackground(Color c);
    void setFont(Font f);
    // etc.
```

Responds for delegation to Graphics and setting several params

Heavyweight components

We have implementations of peers only for several heavyweight components.

Graphics2D

Anything may contain Graphics2D

Responds for drawing:

```
abstract class Graphics2D {
    public abstract void drawImage(BufferedImage img,
                                   BufferedImageOp op,
                                   int x, int y);
    public abstract void drawString(String str, int x, int y);
    public abstract void fill(Shape s);
    // etc.
```

How the hell will it work in a browser?

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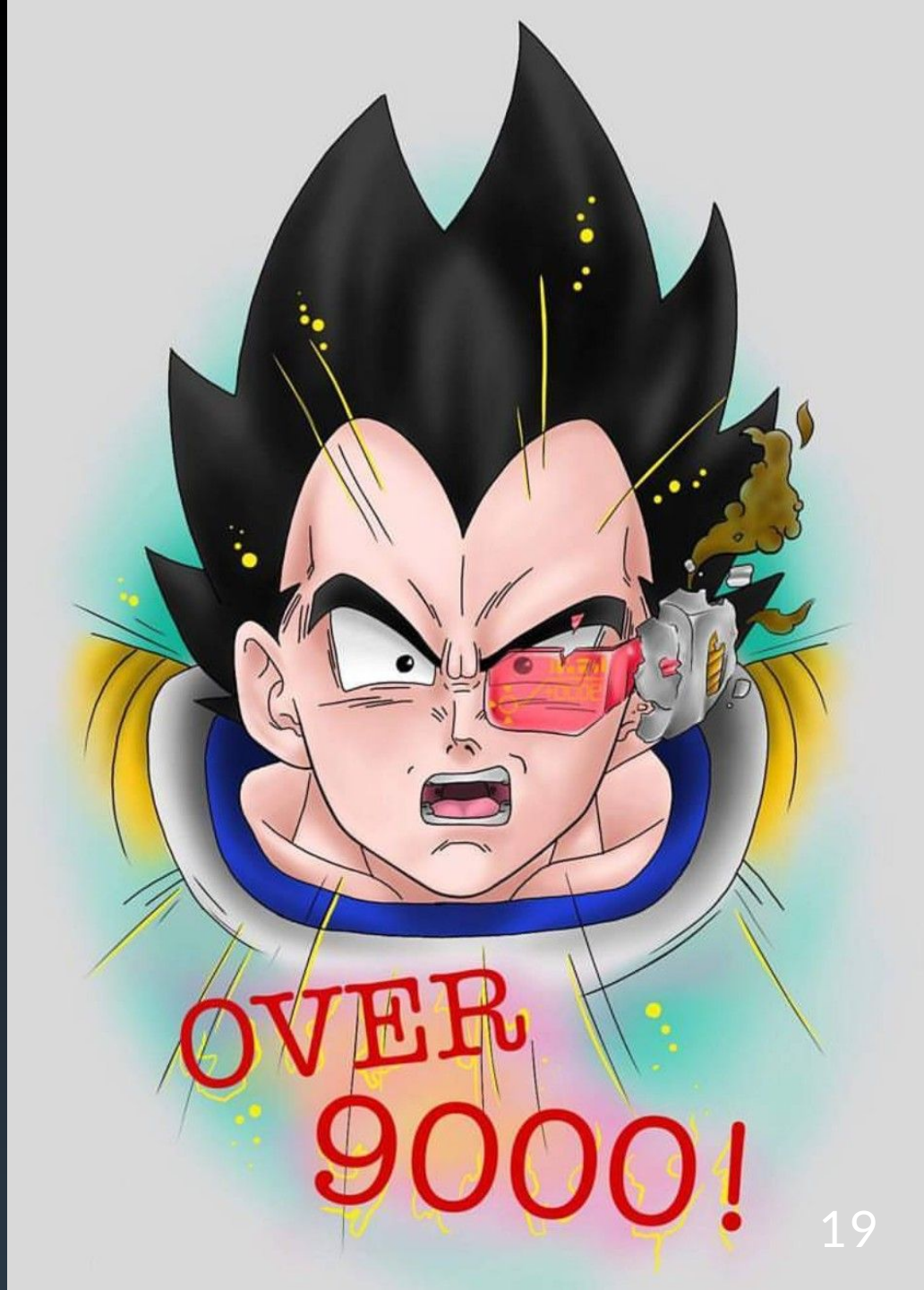
The initial version just sent the whole screen to the client.

It had a whopping performance of ≈5 fps 😯



How the hell will it work in a browser?

Welcome DrawEventQueue

Queue that will transform any action into an event, based on

```
ConcurrentLinkedQueue<List<ServerWindowEvent>>()
```

DrawEventQueue

Each component has its queue (for now)

```
private inline fun paintArea(
    crossinline command: DrawEventQueue.CommandBuilder.() -> Unit
) {
    drawEventQueue
        .buildCommand()
        .setClip(identitySpaceClip = identitySpaceClip)
        .setTransform(transform.toList())
        .setComposite(backingComposite)
        .command()
}
```

Images

There are at least five types of images in AWT 😱

`VolatileImage`:

- is used to display off-screen surfaces
- is drawn by primitives
- is being sent as commands.

Images

`BufferedImage`:

- is being sent as bitmap
- we have sophisticated reflection-based heuristics to determine if it is changed
- may be optimized in future

Images

`MultiresolutionImage`:

- used for drawing icons
- supported only if it has the single resolution

Images

Other types of images are not supported right now.

So we have commands. Now what?

```
while(!stopped){
    sendAllCommands() // sends both images and command
    Thread.sleep(10)
}
```

Every 10ms (roughly), aggregate all commands and send them to the client over WebSocket.

Format

Default format: highly optimized JSON
Supported OOTB formats: Protobuf, JSON
May support anything if we'll implement it on both sides.

Format


```
[["e",{"a":["a",{"a":2}],"b":[["h",{"a":["a",{"a":252.0,"b":78.0,"c":26.0,"d":24.0}]}],
["p",{"a":[1.0,0.0,0.0,1.0,21.0,76.0]}],["i",{"a":
["a",{"a":1.0,"b":"a","c":"c","d":10.0,"e":0.0,"f":null}]}],
["s",{"a":["a",{"a":-12828863}]}],["r",{"a":["a",{"a":"a","b":1.0}]}],
["d",{"a":"b","b":0.0,"c":0.0,"d":478.0,"e":28.0}],["p",{"a":
[1.0,0.0,0.0,1.0,252.0,78.0]}],["l",{"a":["a",{"a":1024,"b":-172147019}],"b":
["b",{"a":5,"b":4,"c":16,"d":16,"e":null}]}]]}]]
```


Everything is determined in runtime — types, fields, etc.
For example, `"e"` at the very beginning is type!

Backend

- Ktor?
- Tomcat?
- Undertow?
- Netty?
- Jetty?


nope.

GPL is not always a good thing

Popular products are not compatible with it, and we HAVE TO publish source code under GPL license.

So...

TooTallNate/Java-WebSocket

And a bunch of crutches to add HTTP support there.

Clients

A client should implement ≈30 API methods of drawing + request resources

The excellent part of Kotlin: we can share some logic between client and server (and we do).

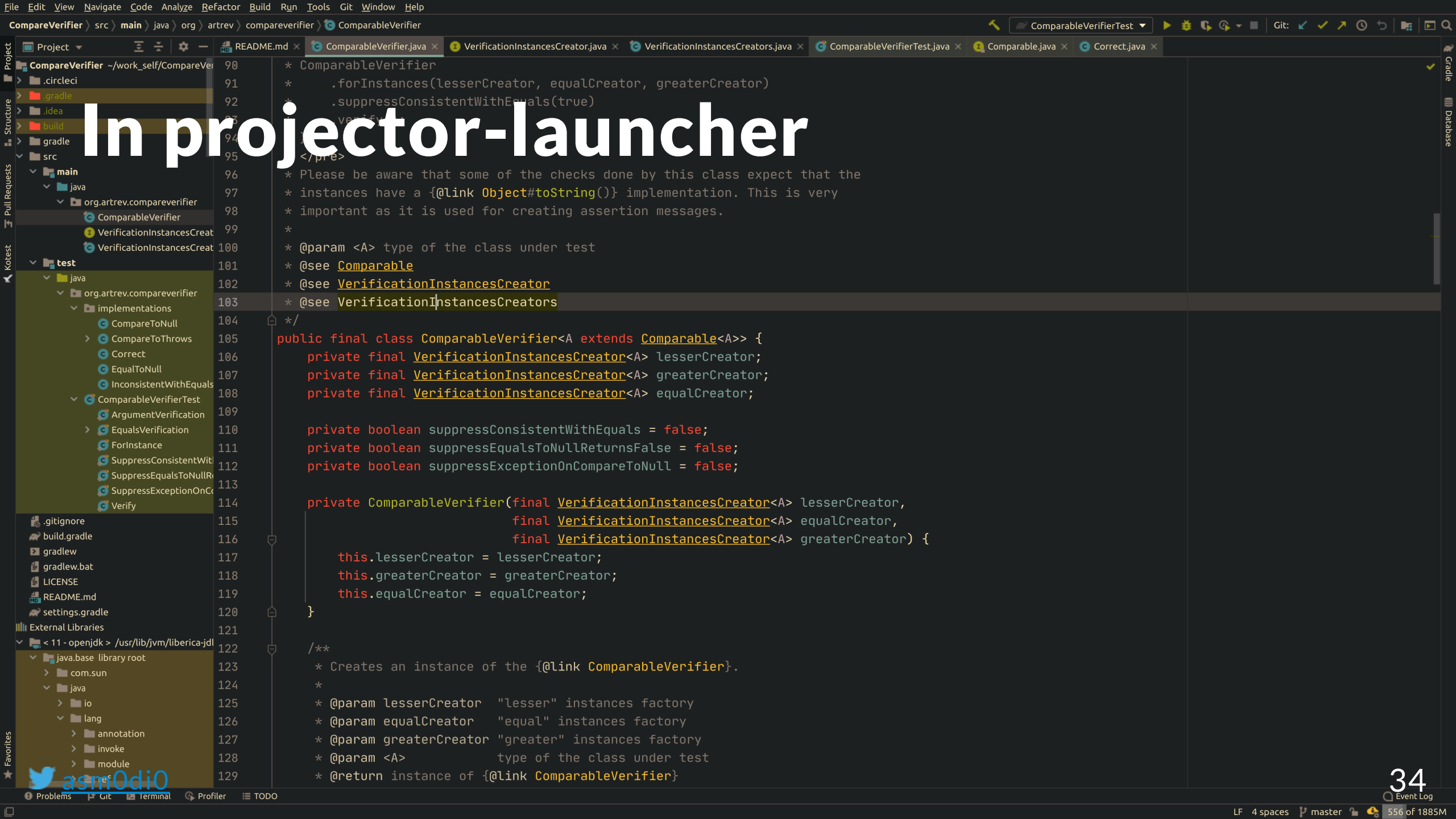
`kotlinx.serialization` *may* do things more straightforward (but deserialization is sooo slow).

A non-read-only client should be able to send mouse and keyboard events, and so on.

In browser

```
888             }
889
890             @Override
891             public String toString() {
892                 return "equals(" + initializer + ")";
893             }
894         }
895
896         @Test
897         public void should_fail_when_elements_are_not_transitively_equal() {
898             final VerificationInstancesCreator<TestComparable> lesser =
899                     VerificationInstancesCreators.from(
900                             new LesserTestComparable()
901                     );
902             final VerificationInstancesCreator<TestComparable> equal =
903                     VerificationInstancesCreators.from(
904                             new EqualTestComparable( initializer: 1),
905                             new EqualTestComparable( initializer: 2),
906                             new EqualTestComparable( initializer: 7)
907                     );
908             final VerificationInstancesCreator<TestComparable> greater =
909                     VerificationInstancesCreators.from(
910                             new GreaterTestComparable()
911                     );
912
913             expectedException.expect(AssertionError.class);
914             expectedException.expectMessage( substring: "equals(1) equals to equals(7), equals(2) equals to equals(7), but equals(1) is not equal to equals(2)");
915
916             ComparableVerifier
917                     .forInstances(lesser, equal, greater)
918                     .suppressConsistentWithEquals(true)
919                     .verify();
920
921         }
```

"Kotlin" plugin update available
Update Plugin Settings... Ignore this update


In projector-launcher
asm0di0
34

Desktop client

- Electron-based
- (Almost) all browser hotkeys are disabled
- May me expanded to full screen

Installation: GNU/Linux

```
pipx install projector-installer
```

```
❯ projector run
           1. DataGrip
           2. IntelliJ
           3. IntelliJ_IDEA_Toolbox_ch-0
Choose a configuration number or 0 to exit: [0-3]: 1
Configuration name: DataGrip
To access IDE, open in browser
        http://localhost:9876/?token=qwertyuiop%21%40%23%24%25%5E%26%2A%28%29
        http://127.0.0.1:9876/?token=qwertyuiop%21%40%23%24%25%5E%26%2A%28%29
        http://192.168.1.111:9876/?token=qwertyuiop%21%40%23%24%25%5E%26%2A%28%29

To see Projector logs in realtime run
        tail -f "/home/finkel/.projector/configs/DataGrip/projector.log"

Exit IDE or press Ctrl+C to stop Projector.
```

Configuration

```
❯ projector config edit
          1. DataGrip
          2. IntelliJ
          3. IntelliJ_IDEA_Toolbox_ch-0
Choose a configuration number or 0 to exit: [0-3]: 1
Edit configuration DataGrip
Enter the path to IDE (default: /home/finkel/.projector/apps/DataGrip-2020.3.2, <tab> for complete):
Enter a Projector listening port (press ENTER for default) [9876]:
Would you like to specify listening address (or host) for Projector? [y/N]
Would you like to specify custom DNS names for Projector access? [y/N]
Use secure connection (this option requires installing a projector's certificate to browser)? [y/N]
Would you like to set password for connection? [y/N]
```

Installation: Docker

JetBrains/projector-docker

```
docker pull \
    registry.jetbrains.team/p/prj/containers/projector-idea-u
docker run --rm -p 8887:8887 -it \
    registry.jetbrains.team/p/prj/containers/projector-idea-u
```

Useful scripts

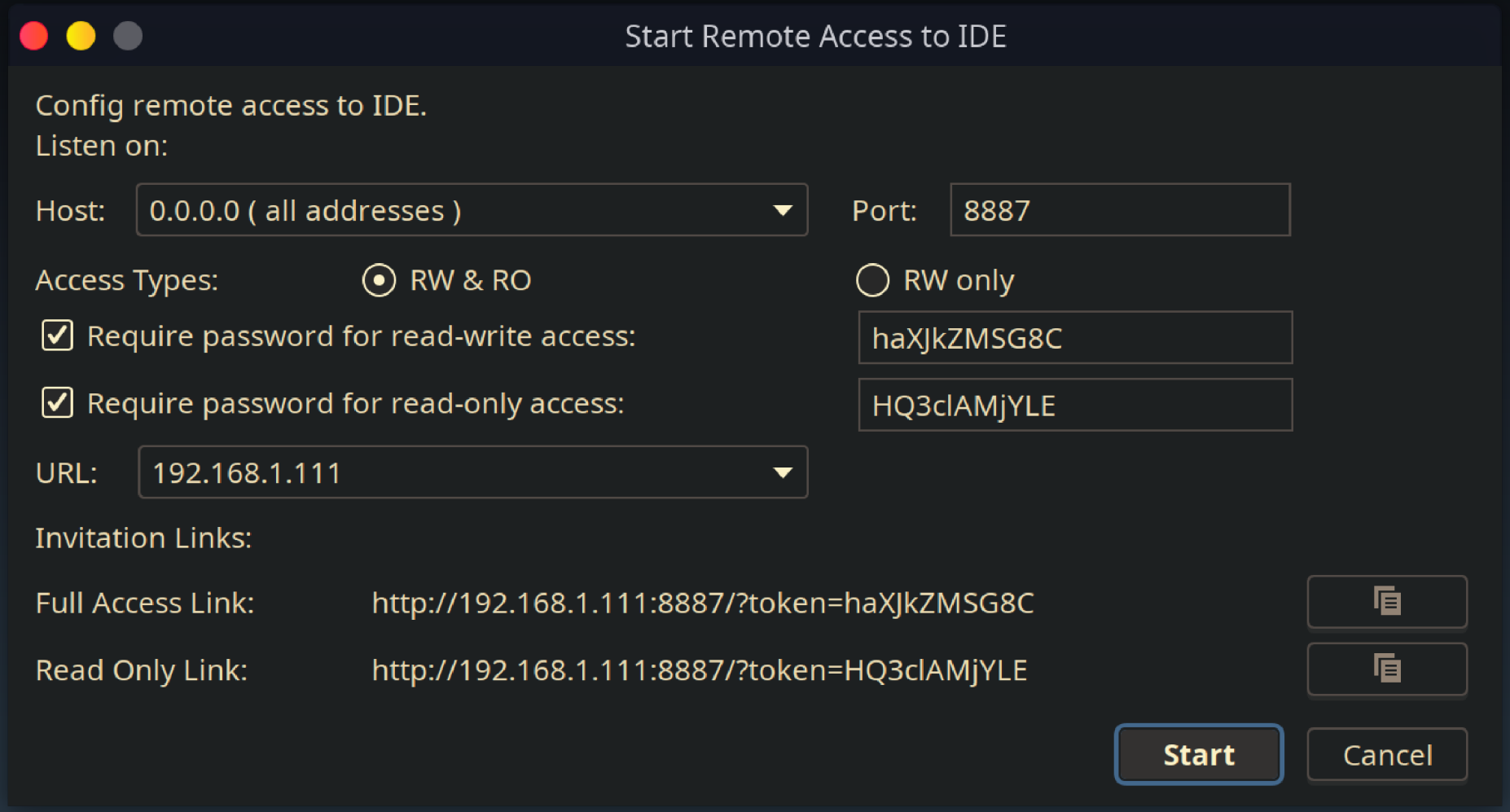
- Build a container with IDE of your choice

  `build-container.sh [containerName [ideDownloadUrl]]`
- Run Stateless container

  `run-container.sh [containerName]`
- Run container with mounted directory to preserve state

  `run-container-mounted.sh [containerName]`

Installation: IDE



How does it work?

```
$DRAW_HANDLER_CLASS_LOADING
clazz
    .getMethod(
        "handleGraphics2D",
        new Class[] { String.class, Object[].class, java.awt.Graphics.class})
    .invoke(
        null,
        new Object[] { "${it.longName}", $JAVASSIST_ARGS, $JAVASSIST_THIS});
```

Adds one more call to every drawing method

How does it compare to CWM?

- It's not a tool for collaborative development (for now)
- Allows displaying any IDE component
- Very comfortable to help/comment on somebody's issues

Place for improvement

- Visual glitches
- Support for (more) AWT components
- Improve HiDPI support
- Speculative typing (?)
- iOS (Android?) native clients (Flutter?)
- Queue optimization
- **You** name it

What did we learn?

- UI operations can be buffered
- There are not so many REAL UI operations
- Cross-platform drawing is achievable
- Parts of code may be reused between server and client

projector.jetbrains.com

Thank you

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