CodeQL as an audit ~~oracle~~ palantir

@pwntester

> whoami

Alvaro Muñoz

@pwntester

Staff Security Researcher with GitHub

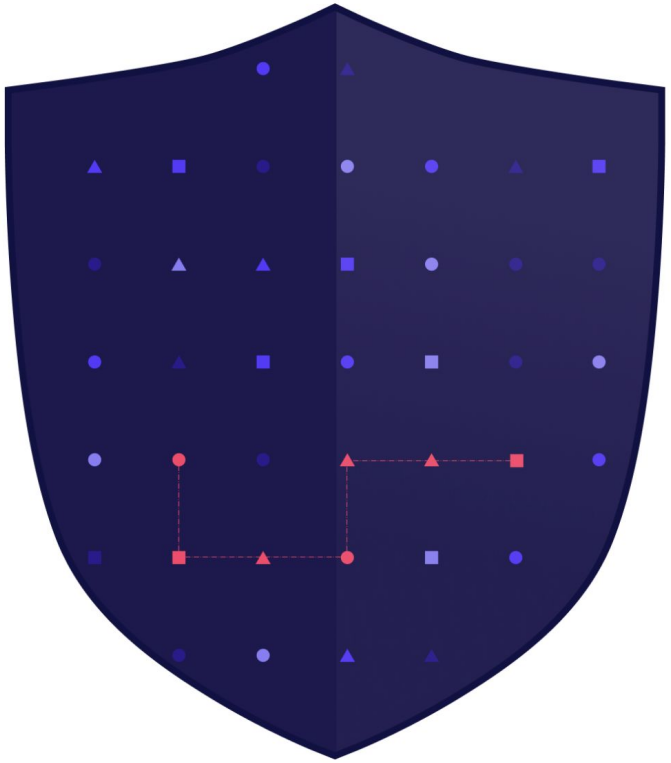
Presented at BlackHat, DEFCON,
OWASP AppSec, ...

Mostly focused on Java research and
web technologies

100+ RCE CVEs :)

GitHub Security Lab

https://securitylab.github.com



Today we will learn

- What CodeQL is
- How to write queries in CodeQL to identify patterns in code
- How to use CodeQL to assist your code review efforts

https://github.com/github/codeql-dubbo-workshop

Agenda

Day 1

1. Intro to CodeQL
2. Case Study: Apache Dubbo
3. Hands-on exercises

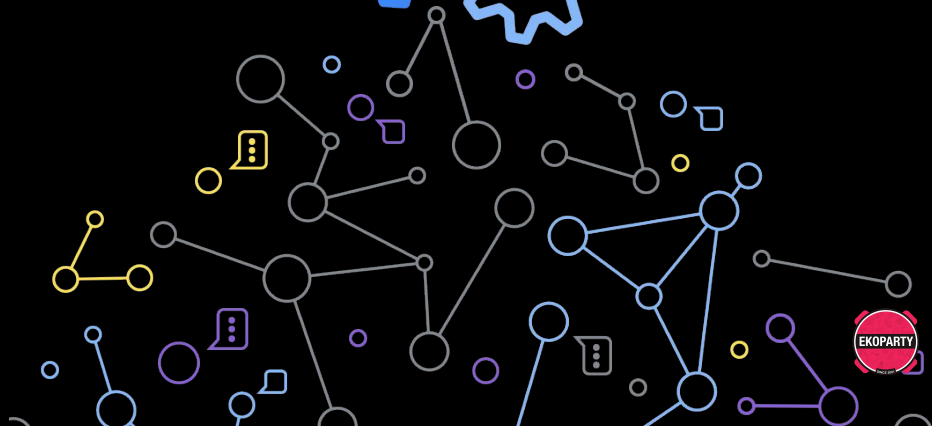
Day 2

1. Case Study: Apache Dubbo
2. Hands-on exercises

Disclaimer

- I am a CodeQL **user** but do not work on the CodeQL implementation itself
- My aim is to provide you with a practical and working understanding of how to use CodeQL for code auditing by giving you the tips, tricks, and mental models that we found useful in our own vulnerability research
- Think of this talk as a bootstrap session :)

What is CodeQL?



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An expressive query language and engine for code analysis

- Treats code as data
- Lets you describe and find patterns in the code
- Toolchain: CLI and IDE

What can I do with it?

- Find bugs and security vulnerabilities
- Quickly make your analyses more precise
- Assist you during code reviews
- Share security knowledge within your teams using codified, readable and executable queries

CodeQL is ...

- Logical
- Declarative - no side effects
- Object-oriented
- Read-only
- Equipped with rich standard libraries for analyzing source code

What does a query look like?

Import: lets us reuse logic
defined in other libraries

```
import java
```

```
from IfStmt ifStmt, Block block
where
  block = ifStmt.getThen() and
  block.getNumStmt() = 0
select ifStmt, "This if-statement has an empty then block."
```

Query clause: describes what we are trying to find

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Building blocks of a query

Predicates

Like functions, but better!

Create reusable logic and give it a name.

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Just a query

```
from IfStmt ifStmt, Block block
where
  block = ifStmt.getThen() and
  block.getNumStmt() = 0
select ifStmt
```

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Using a predicate

```
predicate isEmpty(Block block) {
  block.getNumStmt() = 0
}

from IfStmt ifStmt
where isEmpty(ifStmt.getThen())
select ifStmt
```

Classes

Describe a set of values.

Using a predicate

```
predicate isEmpty(Block block) {
  block.getNumStmt() = 0
}

from IfStmt ifStmt
where isEmpty(ifStmt.getThen())
select ifStmt
```

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Using a class

```
class EmptyBlock extends Block {
  EmptyBlock() {
    this.getNumStmt() = 0
  }
}

from IfStmt ifStmt
where ifStmt.getThen() instanceof
EmptyBlock
select ifStmt
```

Using a predicate

```
predicate isEmpty(Block block) {
  block.getNumStmt() = 0
}

from IfStmt ifStmt
where isEmpty(ifStmt.getThen())
select ifStmt
```

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Using a class

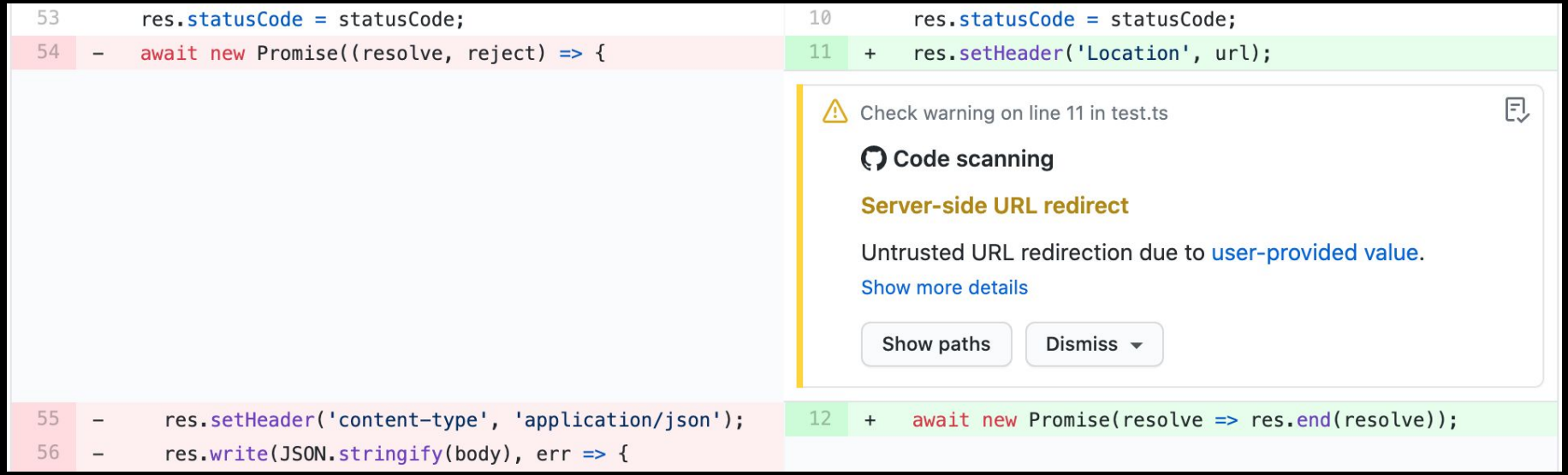
```
class EmptyBlock extends Block {
  EmptyBlock() {
    this.getNumStmt() = 0
  }
}

from IfStmt ifStmt, EmptyBlock block
where ifStmt.getThen() = block
select ifStmt
```

Common uses of CodeQL

1. Automated scans with built-in or custom queries
2. Variant analysis
3. Assist during manual code review

Automated scans

- Toll gates 👎 or guardrails 👍
- Ideally integrated into the build pipeline
  - Run on every commit or PR
  - Immediate feedback to developers



Variant analysis

- Take a known vulnerability and model its characteristics into a CodeQL query
- Run that query across a bunch of projects to find similar vulnerabilities
- Example: Bean Stalking: Growing Java beans into RCE
  - Variant Analysis of CVE-2018-16621 (Bean Validation EL injection) by @pwntester
  - Multiple RCE (Netflix Conductor, Netflix Titus, Apache Syncope, Sonatype Nexus, Corona-Warn-App, ...)

Code Auditing

- The iterative process of answering questions about code to establish vulnerability hypotheses
  - pwndering: verb, “can this or that happen in such and such way that could lead to a vuln?”
- CodeQL can help answer those questions
  - Challenges:
    - Knowing WHAT you want to ask
    - Knowing HOW to ask it
- Clear questions translate into clear queries
- Fuzzy questions translate into fuzzy queries

Ask the OraQL

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Ask the OraQL

Common Auditing Questions

- What is my attack surface?
- Is this code even executed?
- Where does my user-controlled input end up?
- Which integer arithmetic can I influence?
- Which parts of the code are high in bug density?
- ...

Case study

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apache/**dubbo**

Apache Dubbo is a high-performance, java based, open source RPC framework.

355 Contributors

885 Issues

36k Stars

24k Forks

FOFA

"dubbo" && port="20880"

API member Log in

all

feature

RxVZ/l...	2
9no7b...	1
SeGF...	1

Country/Region Ranking

China	5,419
America	524
Hong Kong Special ...	243
Singapore	239
South Africa	196

Port ranking

20880	6,772

Server ranking

Jetty(6.1.26)	2
BaseHTTP/0.6 360 web server, 7...	1
Jetty (6.1.x)	1

Agreement ranking

apache-dubbo	6,765
https	1

Site title ranking

6,772 matching results (6,770 Independent IP) , 57 ms , keyword search .

Show data within one year, click all to view all.

Eliminate interference with one click

API

mobile.docin.com

221.122.117.118
China
ASN: 4808
Organization: China Unicom Beijing Province Network
docin.com
2021-10-02

20880 apache-dubbo

Unsupported command: GET dubbo>

ip-148-72-246-110.ip.secureserver.net

148.72.246.110
America
ASN: 26496
Organization: AS-26496-GO-DADDY-COM-LLC
secureserver.net
2021-09-30

20880 apache-dubbo

Unsupported command: GET dubbo>

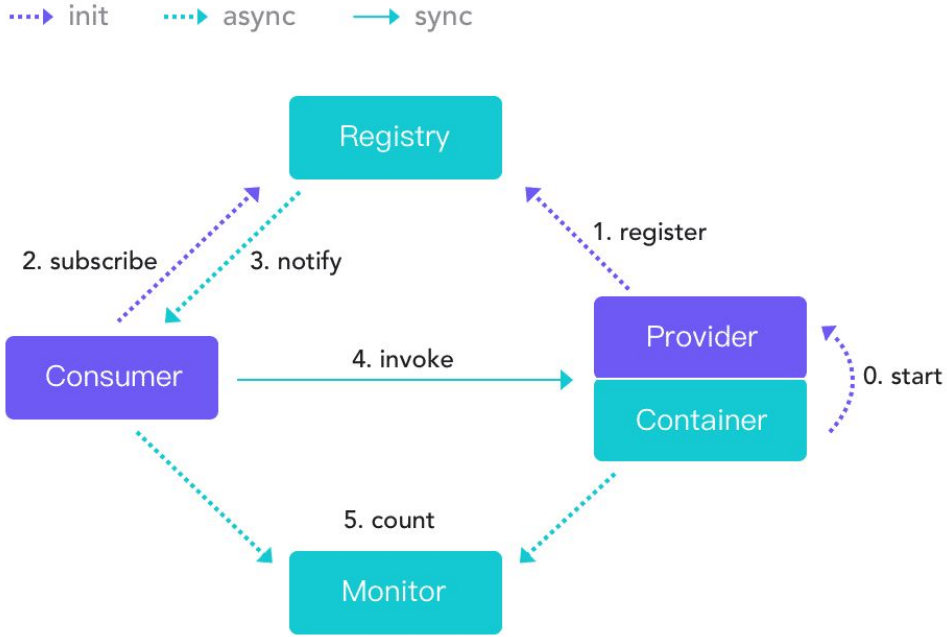
39.98.217.49

39.98.217.49
China
ASN: 37963
Organization: Hangzhou Alibaba Advertising Co.,Ltd.
2021-09-17

20880 apache-dubbo

Unsupported command: GET dubbo>

Dubbo Architecture



Past vulnerabilities 

CVE-2020-11995

A Hessian2 deserialization vulnerability could lead to malicious code execution. This vulnerability was addressed by establishing a mechanism for users to set deserialization allow/block lists.

CVE-2020-1948

An attacker can send RPC requests with an unrecognized service name or method name along with some malicious parameter payloads. When the malicious parameter is deserialized, it will execute some malicious code.

CVE-2019-17564

Unsafe deserialization occurs within a Dubbo application which has Spring HTTP remoting enabled.

New 🐛 from this audit

GHSL-2021-035	CVE-2021-25641	Bypass Hessian2 allowlist via alternative protocols
GHSL-2021-036	🥺	Pre-auth RCE via multiple Hessian deserializations in the RPC invocation decoder
GHSL-2021-037	CVE-2021-30179	Pre-auth RCE via Java deserialization in the Generic filter
GHSL-2021-038	CVE-2021-30179	Pre-auth RCE via arbitrary bean manipulation in the Generic filter
GHSL-2021-039	CVE-2021-32824	Pre-auth RCE via arbitrary bean manipulation in the Telnet handler
GHSL-2021-040	CVE-2021-30180	RCE on customers via Tag route poisoning (Unsafe YAML unmarshaling)
GHSL-2021-041	CVE-2021-30180	RCE on customers via Condition route poisoning (Unsafe YAML unmarshaling)
GHSL-2021-042	CVE-2021-30181	RCE on customers via Script route poisoning (Nashorn script injection)
GHSL-2021-043	CVE-2021-30180	RCE on providers via Configuration poisoning (Unsafe YAML unmarshaling)
GHSL-2021-094	CVE-2021-36162	RCE on customers via MeshApp route poisoning (Unsafe YAML unmarshaling)
GHSL-2021-095	CVE-2021-36163	Pre-Auth Unsafe Hessian deserialization when Hessian protocol is used
GHSL-2021-096	🥺	Pre-Auth Unsafe Java deserialization when RMI protocol is used
GHSL-2021-097	CVE-2021-37579	Bypass `checkSerialization` security control

Ex1: The attack surface 

- Use `semmle.code.java.dataflow.FlowSources.RemoteFlowSource`

```
import java
import semmle.code.java.dataflow.FlowSources

from RemoteFlowSource source
select source
```

- Exclude those ones with paths matching `*/src/test/*`
- Select the source, enclosing class and source type

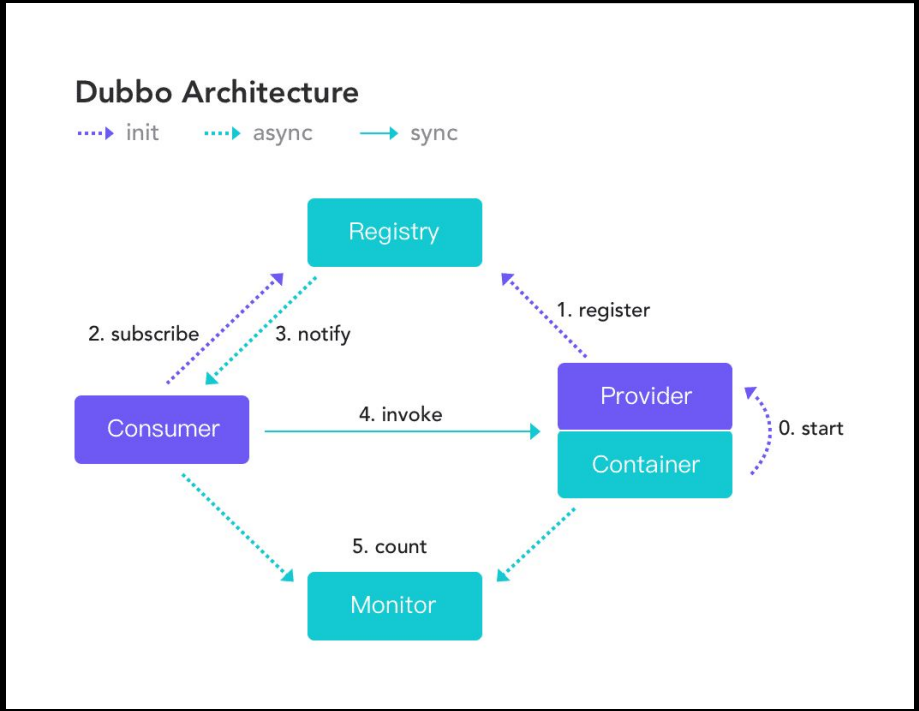
```
import java
import semmle.code.java.dataflow.FlowSources

from RemoteFlowSource source
where
  not source.getLocation().getFile().getRelativePath().matches("%/src/test/%")
select source, source.getEnclosingCallable().getDeclaringType(), source.getSourceType()
```

#select

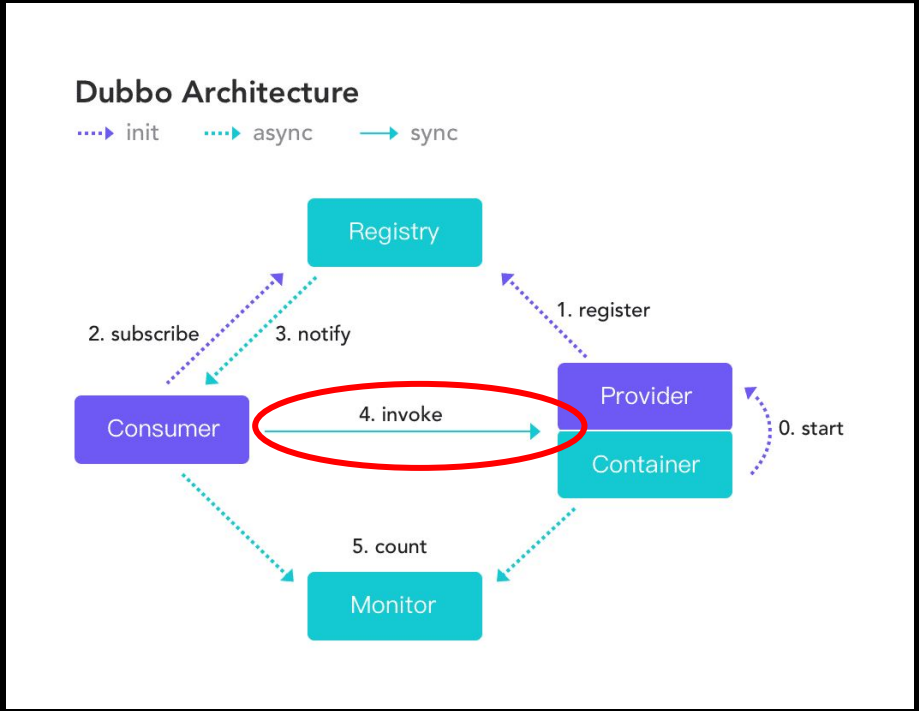
10 results

#	source	[1]	[2]
1	getHostName(...)	NetUtils	reverse DNS lookup
2	getHostName(...)	NetUtils	reverse DNS lookup
3	getContent(...)	HttpClientConnection	external
4	getRequestURI(...)	HessianHandler	external
5	getHeaderNames(...)	HessianHandler	external
6	getHeader(...)	HessianHandler	external
7	getInputStream(...)	HessianHandler	external
8	getRequestURI(...)	InternalHandler	external
9	getInputStream(...)	InternalHandler	external
10	getRequestURI(...)	InternalHandler	external

Identifying attack surface

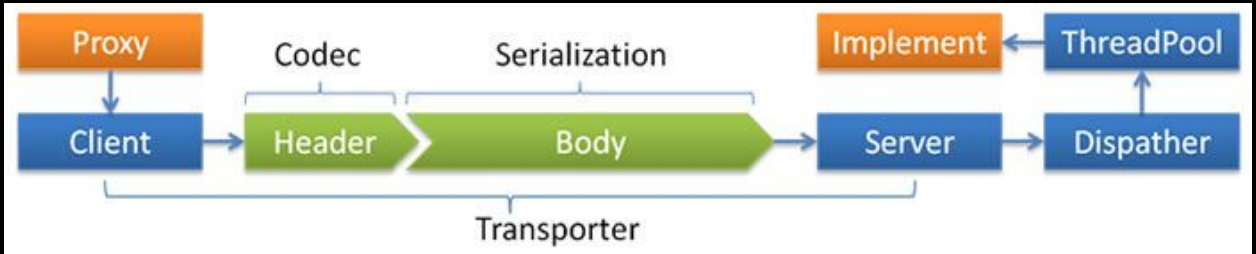


Identifying attack surface

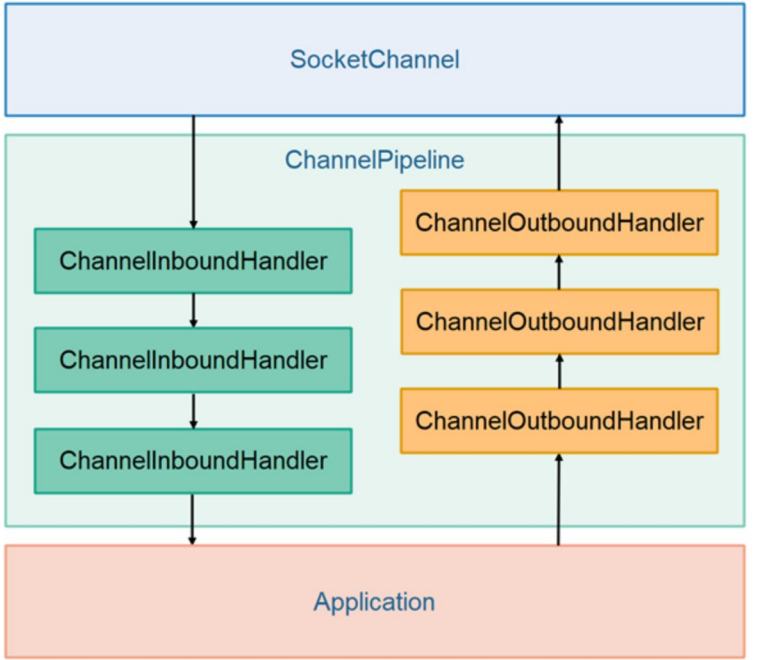


Identifying attack surface

- Dubbo transporters
  https://dubbo.apache.org/docs/v2.7/dev/impls/remoting/
  - Netty (default one)
  - Mina
  - Grizzly



Netty 101



Package	`io.netty.channel`
Class	`ChannelInboundHandler`
Method	`channelRead & channelRead0`
Parameters	`ChannelHandlerContext ctx` `Object msg`

Package	`io.netty.handler.codec`
Class	`ByteToMessageDecoder`
Method	`decode & decodeLast`

Parameters	`ChannelHandlerContext ctx`
	`ByteBuf in`
	`List<Object> out`

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Ex2: Model Netty sources

Model `channelRead` and `decode` sources. Eg:

```
import semmle.code.java.dataflow.FlowSources

class XXXXXX extends RemoteFlowSource {
    XXXXXX() {
        none()
    }
    override string getSourceType() {
        result = "<Source description>"
    }
}
```

```
/** The ChannelInboundHandler class */
class ChannelInboundHandler extends Class {
  ChannelInboundHandler() {
    this.getASourceSupertype*().hasQualifiedName("io.netty.channel", "ChannelInboundHandler")
  }
}

/** The ChannelInboundHandlerl.channelRead method */
class ChannelReadMethod extends Method {
  ChannelReadMethod() {
      this.getName() = ["channelRead", "channelRead0", "messageReceived"] and
      this.getDeclaringType() instanceof ChannelInboundHandler
  }
}

/** The ChannelInboundHandlerl.channelRead(1) source */
class ChannelReadSource extends RemoteFlowSource {
    ChannelReadSource() {
      exists(ChannelReadMethod m |
        this.asParameter() = m.getParameter(1)
      )
    }
    override string getSourceType() { result = "Netty Handler Source" }
}
```

#select

6 results

#	source	[1]	[2]
1	msg	HttpProcessHandler	Netty Handler Source
2	in	QosProcessHandler	Netty Decoder Source
3	msg	TelnetProcessHandler	Netty Handler Source
4	msg	NettyClientHandler	Netty Handler Source
5	input	InternalDecoder	Netty Decoder Source
6	msg	NettyServerHandler	Netty Handler Source

CodeQL as an audit oracle

Day 2

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Where we left?

User data

```
private class InternalDecoder extends ByteToMessageDecoder {

    @Override
    protected void decode(ChannelHandlerContext ctx, ByteBuf input, List<Object> out) throws Exception {

        ChannelBuffer message = new NettyBackedChannelBuffer(input);

        NettyChannel channel = NettyChannel.getOrAddChannel(ctx.channel(), url, handler);

        // decode object.
        do {
            int saveReaderIndex = message.readerIndex();
            Object msg = codec.decode(channel, message);
            if (msg == Codec2.DecodeResult.NEED_MORE_INPUT) {
                message.readerIndex(saveReaderIndex);
                break;
            } else {
                //is it possible to go here ?
                if (saveReaderIndex == message.readerIndex()) {
                    throw new IOException("Decode without read data.");
                }
                if (msg != null) {
                    out.add(msg);
                }
            }
        } while (message.readable());
    }
}
```

Used here

Dubbo Protocol

Offsets Octet		0								1								2								3							
Octet	Bit	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
0	0	Magic High								Magic Low								Req/Res	2 Way	Event	Serialization ID					Status							
4	32	RPC Request ID																															
8	64																																
12	96	Data Length																															
16 ...	128 ...	Variable length part, in turn, is: dubbo version, service name, service version, method name, parameter types, arguments, attachments																															

Dubbo abstractions

- Transport layer abstraction.
    - Netty, Mina and Grizzly call:
    - `DubboCodec.decode()`
    - `DubboCodec.decodeBody(Channel c, InputStream is, byte[] hdrs)`
- Serializer abstraction:
    - `Serialization` class is initialized for a given serialization type
    - `Serialization.deserialize()` wraps an input stream with a concrete `ObjectInput` type
        - Eg: `JavaObjectInput`, `KryoObjectInput`, etc.
        - Note: It ***does not*** perform any deserializations
    - `ObjectInput.readXXX` methods perform the actual deserialization

```
Serialization serialization = CodecSupport.getSerialization(channel.getUrl(), serializationType)
ObjectInput in = serialization.deserialize(channel.getUrl(), inputStream);
in.readObject();
```

Dubbo abstractions

- Transport layer abstraction.
  - Netty, Mina and Grizzly will end up calling
  - `ExchangeCodec.decode()`
  - `DubboCodec.decodeBody(Channel c, InputStream is, byte[] hdrs)`
- Serializer abstraction:
  - `Serialization` class is initialized for a given serialization type
  - `Serialization.deserialize()` wraps an input stream with a concrete `ObjectInput` type
    - Eg: `JavaObjectInput`, `KryoObjectInput`, etc.
    - Note: It ***does not*** perform any deserializations
  - `ObjectInput.readXXX` methods perform the actual deserialization

Our sources

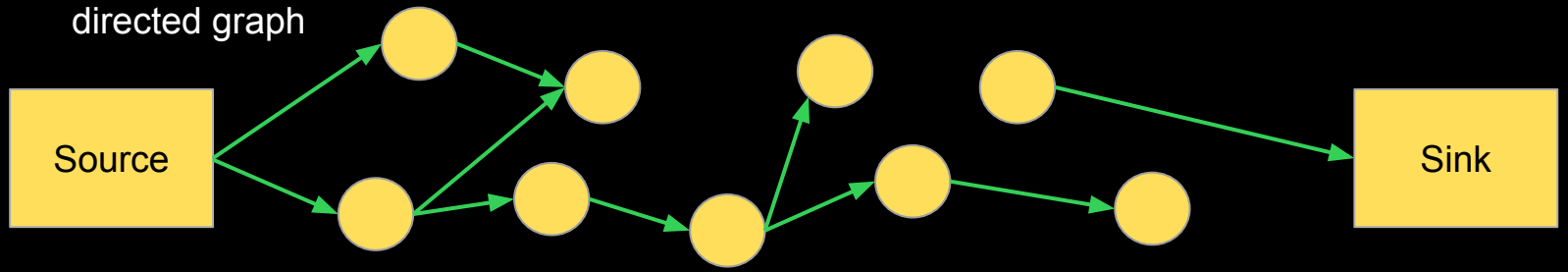
```
Serialization serialization = CodecSupport.getSerialization(channel.getUrl(), serializationType)
ObjectInput in = serialization.deserialize(channel.getUrl(), inputStream);
in.readObject();
```

Our sink (qualifier)

A taint step from 2nd arg to return

Taint Tracking analysis

- Emulate program run and track data from an origin (source) to a destination (sink)
- Taint Tracking analysis requires models (summaries) for method for which we don't have the source code
- We need to configure the CodeQL `TaintTracking` module using a `TaintTracking::Configuration` which is mostly boilerplate to define:
  - Sources (nodes)
  - Sinks (nodes)
  - TaintSteps (optional edges)
  - Sanitizers (optional nodes)
- Dataflow nodes are an abstraction of AST nodes (expressions or parameters) and form a directed graph



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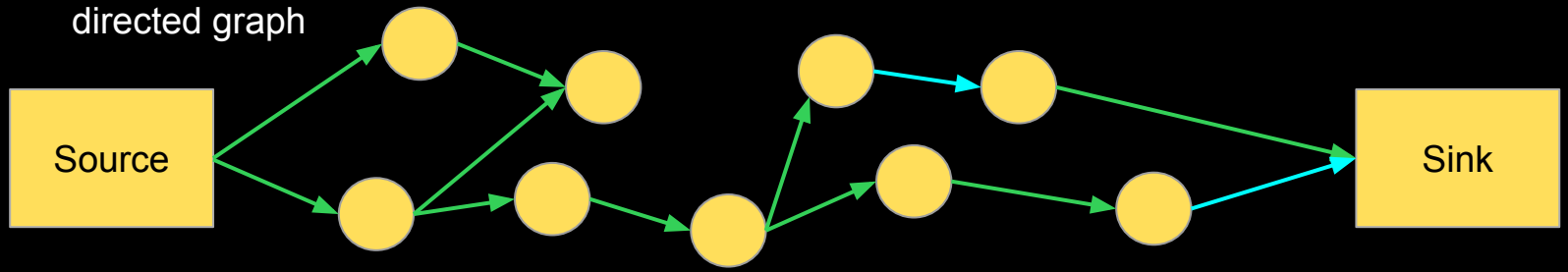

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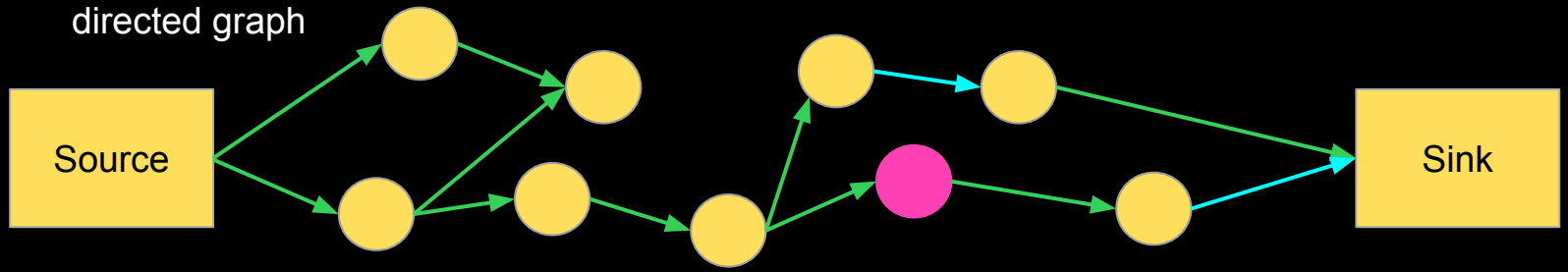

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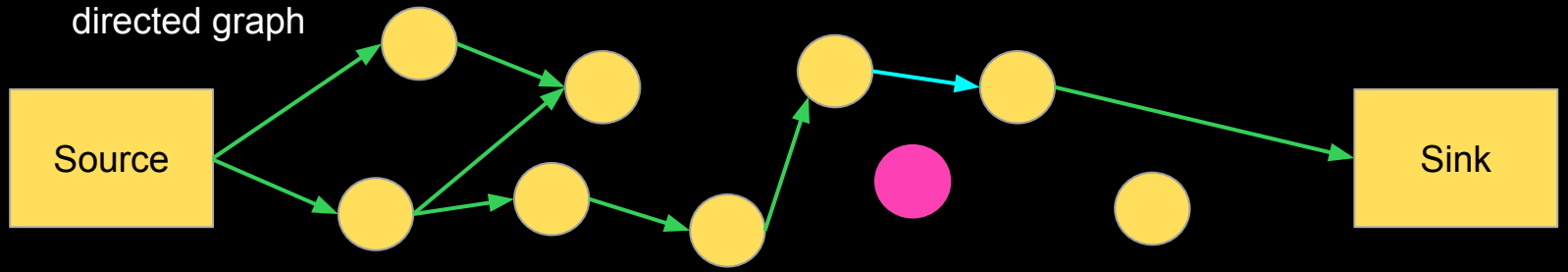

```
/**
 * @kind path-problem
 */

import java
import semmle.code.java.dataflow.TaintTracking
import DataFlow::PathGraph

class MyConfig extends TaintTracking::Configuration {
  MyConfig() { this = "MyConfig" }

  override predicate isSource(DataFlow::Node source) {
    Source
  }

  override predicate isAdditionalTaintStep(DataFlow::Node n1, DataFlow::Node n2) {
    Taint Steps
  }

  override predicate isSink(DataFlow::Node sink) {
    Sink
  }
}

from MyConfig conf, DataFlow::PathNode source, DataFlow::PathNode sink
where conf.hasFlowPath(source, sink)
select sink, source, sink, "source flows into sink"
```

Ex3: Variant analysis

Source:

```
org.apache.dubbo.rpc.protocol.dubbo.DubboCodec.decodeBody (param 1,2)
```

TaintStep:

```
org.apache.dubbo.common.serialize.Serialization.deserialize (arg 1 -> return)
```

Sink:

```
org.apache.dubbo.common.serialize.ObjectInput.read*  (qualifier)
```

10 mins

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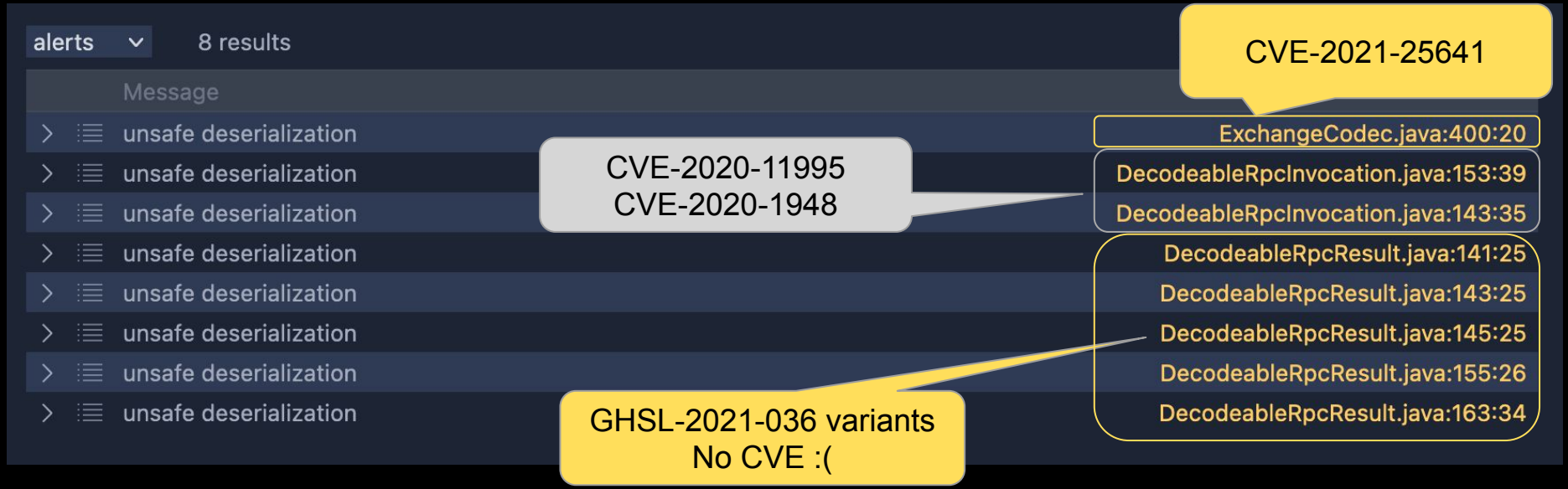
alerts
8 results
Message
unsafe deserialization
unsafe deserialization
unsafe deserialization
unsafe deserialization
unsafe deserialization
unsafe deserialization
unsafe deserialization
unsafe deserialization
CVE-2021-25641
ExchangeCodec.java:400:20
CVE-2020-11995
CVE-2020-1948
DecodeableRpcInvocation.java:153:39
DecodeableRpcInvocation.java:143:35
DecodeableRpcResult.java:141:25
DecodeableRpcResult.java:143:25
DecodeableRpcResult.java:145:25
DecodeableRpcResult.java:155:26
DecodeableRpcResult.java:163:34
GHSL-2021-036 variants
No CVE :(

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Ex4: Semantic matches

- Taint tracking analysis requires modelling of all APIs involved in the taint propagation. Out of the shelve libraries may not model all required APIs 😔
- As part of a **manual code review** we want to verify dangerous ops regardless of user control evidences

1. Find all calls to `ObjectInput.read*()` methods semantically
2. Exclude calls to `read*` within the `ObjectInput` class itself
3. Exclude calls on files with a path matching `*/src/test/*`
4. Output the call, the enclosing method and the enclosing class

5 mins

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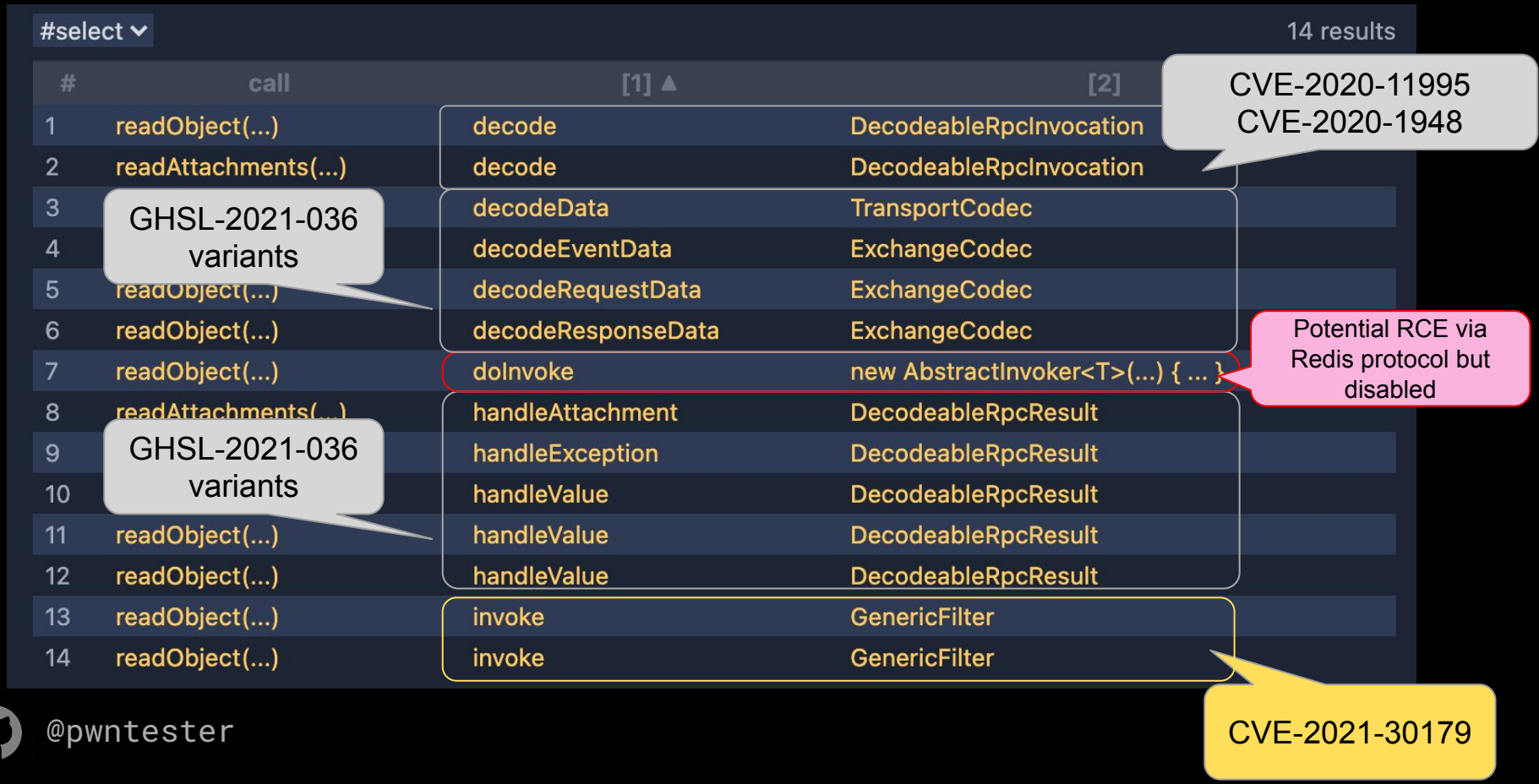
EKOPARTY


#select
14 results
call [1] [2]
1 readObject(...) decode DecodeableRpcInvocation
2 readAttachments(...) decode DecodeableRpcInvocation
3 decodeData TransportCodec
4 decodeEventData ExchangeCodec
5 decodeRequestData ExchangeCodec
6 readObject(...) decodeResponseData ExchangeCodec
7 readObject(...) doInvoke new AbstractInvoker<T>(...) { ... }
8 handleAttachment DecodeableRpcResult
9 handleException DecodeableRpcResult
10 handleValue DecodeableRpcResult
11 readObject(...) handleValue DecodeableRpcResult
12 readObject(...) handleValue DecodeableRpcResult
13 readObject(...) invoke GenericFilter
14 readObject(...) invoke GenericFilter
CVE-2020-11995
CVE-2020-1948
GHSL-2021-036 variants
GHSL-2021-036 variants
Potential RCE via Redis protocol but disabled
CVE-2021-30179

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Ex5: Scaling manual findings

- `GenericFilter` was also vulnerable to arbitrary setter calls via `PojoUtils` and `JavaBeanSerializeUtil`

- Are they used anywhere else?
- Find (semantically) all uses of:
  - `PojoUtil.realize()`
  - `JavaBeanSerializeUtil.deserialize()`
- As usual exclude results on test files

5 mins

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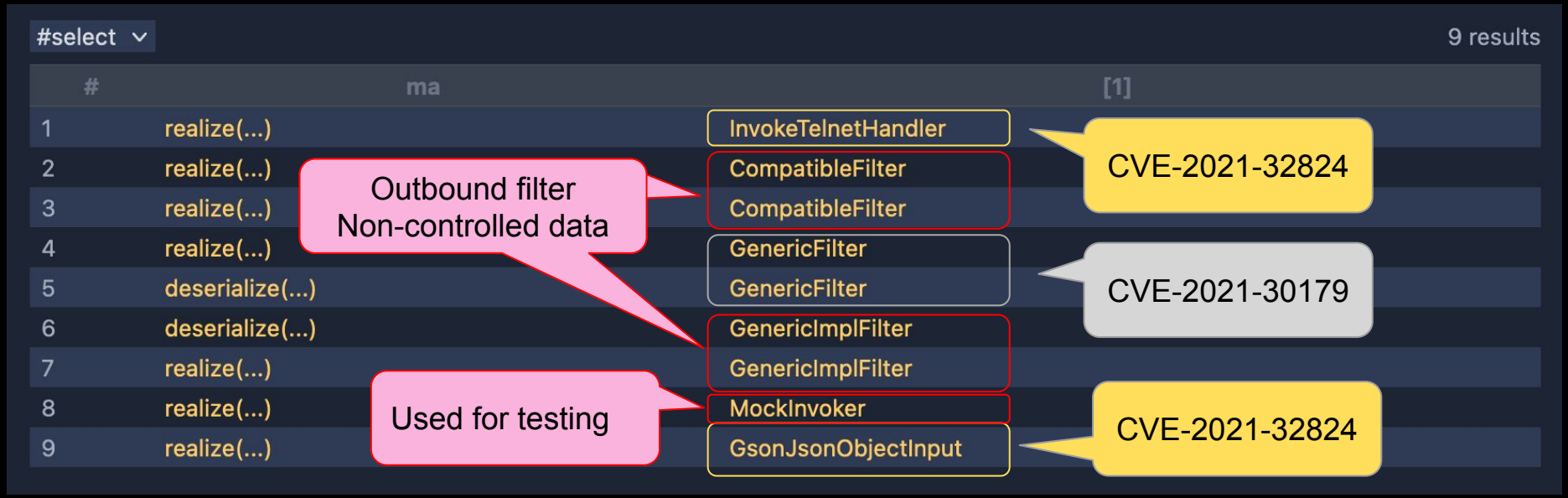
EKOPARTY


#select
9 results
ma [1]
1 realize(...) InvokeTelnetHandler
2 realize(...) CompatibleFilter
3 realize(...) CompatibleFilter
4 realize(...) GenericFilter
5 deserialize(...) GenericFilter
6 deserialize(...) GenericImplFilter
7 realize(...) GenericImplFilter
8 realize(...) MockInvoker
9 realize(...) GsonJsonObjectInput
Outbound filter
Non-controlled data
Used for testing
CVE-2021-32824
CVE-2021-30179
CVE-2021-32824

Ex6: Semantic sinks heatmap

- A best practice is to look for semantic (non-dataflow) matches of the most important taint tracking sinks
- This will give us a heatmap of where dangerous operations take place and therefore a map of files to audit more carefully

1. Find all calls to an unsafe deserialization sinks known to CodeQL
   Reuse `UnsafeDeserializationSink` class
   From `semmle.code.java.security.UnsafeDeserializationQuery`
2. Select sink class, method and call enclosing class

10 mins

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EKOPARTY

#select

23 results

#	[0]	[1] ▼	[2]
1	Kryo	readObjectOrNull(...)	KryoObjectInput2
2	Kryo	readObjectOrNull(...)	KryoObjectInput2
3	Kryo	readObjectOrNull(...)	KryoObjectInput2
4	Hessian2Input	readObject(...)	Hessian2ObjectInput
5	Hessian2Input	readObject(...)	Hessian2ObjectInput
6	ObjectInputStream	readObject(...)	NativeJavaObjectInput
7	ObjectInputStream	readObject(...)	JavaObjectInput
8	Hessian2Input	readObject(...)	Hessian2ObjectInput
9	Hessian2Input	readObject(...)	Hessian2ObjectInput
10	Kryo	readClassAndObject(...)	KryoObjectInput2
11	Kryo	readClassAndObject(...)	KryoObjectInput
12	JSON	parseObject(...)	FastJsonObjectInput
13	JSON	parseObject(...)	FastJsonObjectInput
14	JSON	parseObject(...)	MockInvoker
15	JSON	parseObject(...)	MockInvoker
16	JSON	parseObject(...)	new Function<String,DefaultServiceInstance>(...) { ... }
17	JSON	parseObject(...)	NacosDynamicConfiguration
18	JSON	parse(...)	FastJsonObjectInput
19	JSON	parse(...)	MockInvoker
20	JSON	parse(...)	ServiceInstanceMetadataUtils
21	Yaml	load(...)	TagRuleParser
22	Yaml	load(...)	ConditionRuleParser
23	Yaml	load(...)	ConfigParser

CVE-2021-30180

Bonus track: reverse flow

- In many occasions, we want to hoist a sink to figure out what other methods also behave as sinks

```
public void foo(String str) {
  bar(str);
}

public void bar(String str) {
  baz(str);
}

public void baz(String str) {
  sink(str);
}
```

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Bonus track: reverse flow

- In many occasions, we want to hoist a sink to figure out what other methods also behave as sinks

```
public void foo(String str) {
  bar(str);
}

public void bar(String str) {
  baz(str);
}

public void baz(String str) {
  sink(str);
}
```

- We can consider the followings as sinks:
  - `foo()`
  - `bar()`
  - `baz()`

Bonus track: reverse flow

- Hoist the `Yaml.load()` method to see where its coming from

#select

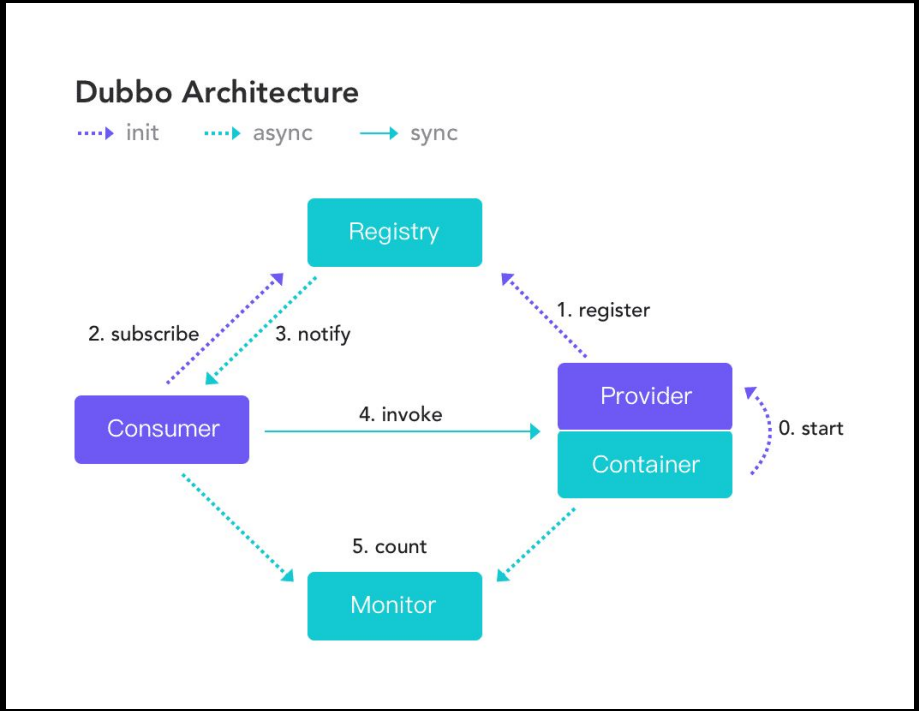
12 results

#	dist	[1]	[2]	n ▲
1	3	NacosConfigListener	innerReceive	configInfo
2	3	ConfigChangedEvent	ConfigChangedEvent	content
3	3	ConfigChangedEvent	ConfigChangedEvent	content
4	1	ListenableRouter	process	event [content]
5	1	TagRouter	process	event [content]
6	3	AbstractConfiguratorListener	process	event [content]
7	3	Optional	orElse	p0
8	1	ConfigParser	parseConfigurators	rawConfig
9	2	AbstractConfiguratorListener	genConfiguratorsFromRawRule	rawConfig
10	5	AppResponse	AppResponse	result
11	3	new Consumer<String>(...) { ... }	accept	v
12	3	CacheListener	dataChanged	value

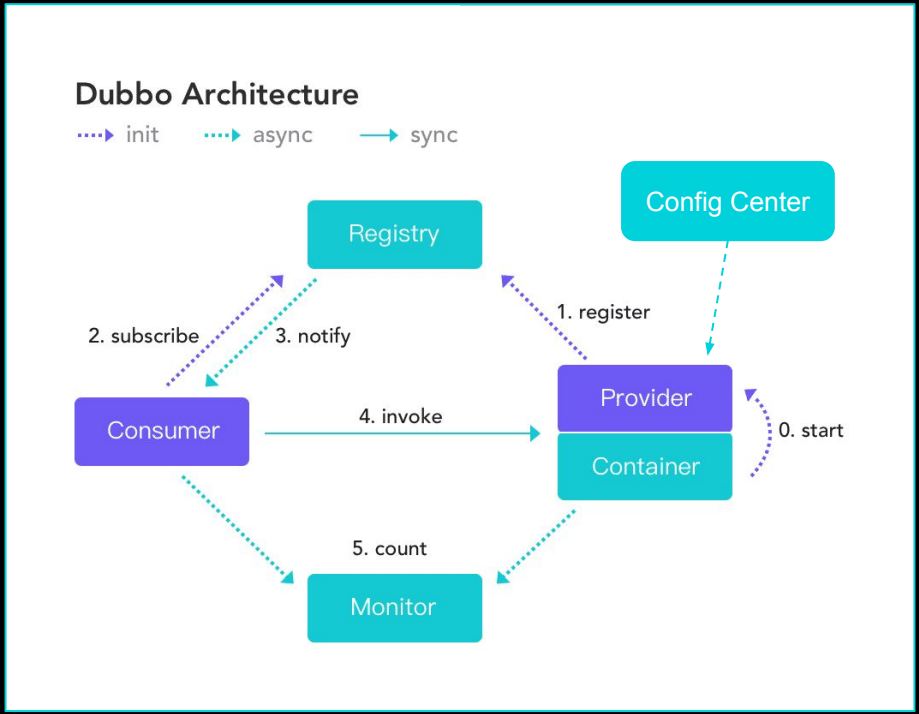
Configuration Centers

- Dataflows to the insecure `YAML.load()` are originated from Configuration Centers (CC) listeners.
- Dubbo CC currently supports ZooKeeper, Nacos, Etcd, Consul and Apollo
- An attacker being able to modify arbitrary configuration objects on the CC may trigger unsafe deserialization ops.
- Hint:
  - Nacos authentication was bypassable (CVE-2021-29441)
    - https://securitylab.github.com/advisories/GHSL-2020-325_326-nacos/
  - Many ZooKeeper instances run with no authentication

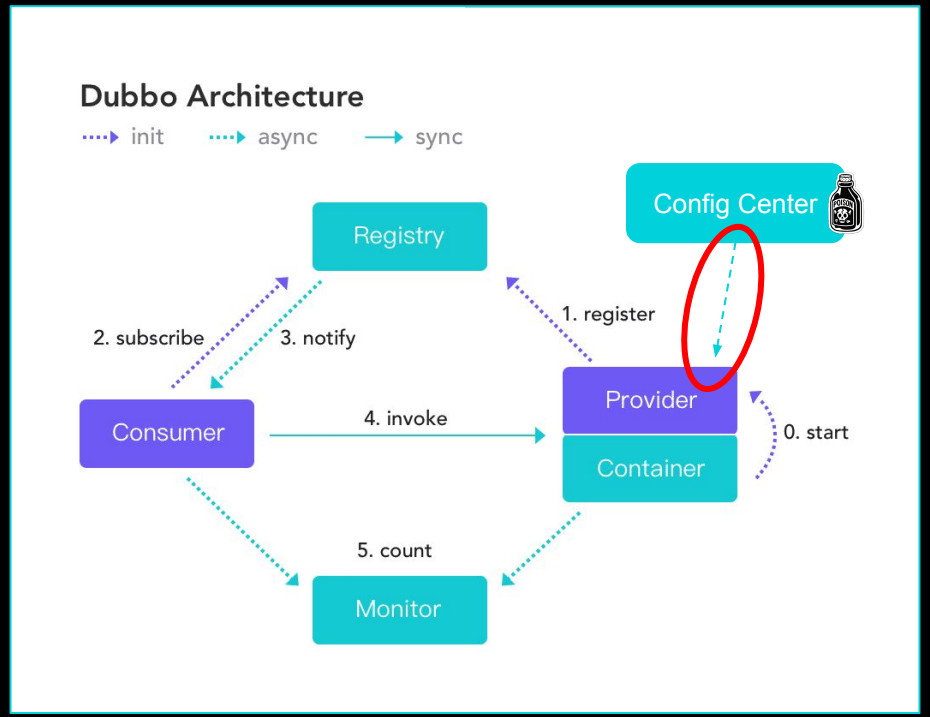
Identifying attack surface



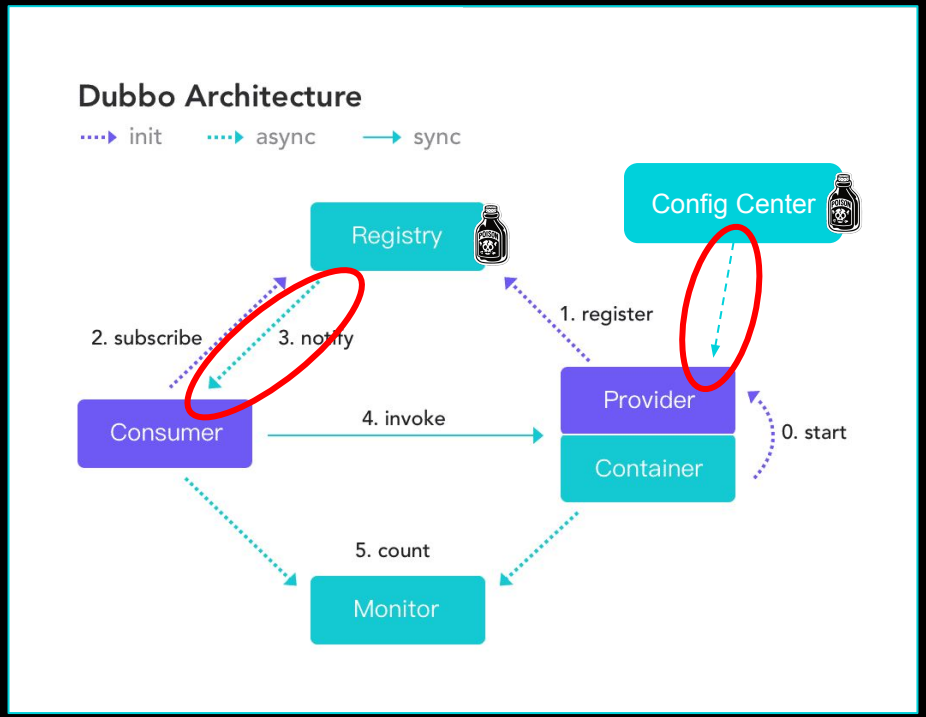
Identifying attack surface



Identifying attack surface



Identifying attack surface



Ex7: Configuration Centers

- Dubbo uses one more abstraction for CCs and another for the Registry
- Model Dubbo **CC** abstraction as a new source

Package	`org.apache.dubbo.common.config.configcenter`
Class	`ConfigurationListener`
Method	`process`
Parameters	`ConfigChangedEvent`

- Model Dubbo **Registry** abstraction as a new source

Package	`org.apache.dubbo.registry`
Class	`NotifyListener`
Method	`notify`
Parameters	`List<URL>`

#	I	[1] ▲	[2]
1	urls	notify	ReverseCompatibleNotifyListener
2	urls	notify	RegistryDirectory
3	urls	notify	OverrideListener
4	arg0	notify	new NotifyListener(...) { ... }
5	urls	notify	MultipleNotifyListenerWrapper
6	urls	notify	SingleNotifyListener
7	event	process	ListenableRouter
8	event	process	TagRouter
9	event	process	new ConfigurationListener(...) { ... }
10	event	process	AbstractConfiguratorListener

Ex8: Script Injection

- Does the new attack surface lead to new issues?
- You may want to run an scan with the complete (default + experimental) set of CodeQL queries and add the new sources and taint steps you developed during the workshop
- Copy the `ScriptInjection` query
  - https://github.com/github/codeql/blob/main/java/ql/src/experimental/Security/CWE/CWE-094/ScriptInjection.ql
- Import sources from Exercise 7
  - `import dubbo`
- Import few JDK models not yet merged to CodeQL repo
  - `import models`

10 mins

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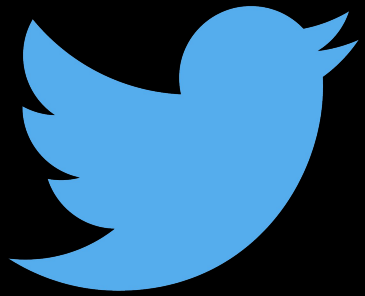
CVE-2021-30181
Message
Java Script Engine evaluate user input. ScriptRouter.java:73:24
Path
1 urls : List RegistryDirectory.java:229:37
2 categoryUrls : Map RegistryDirectory.java:239:32
3 getOrDefault(...) : Object RegistryDirectory.java:239:32
4 routerURLs : Object RegistryDirectory.java:240:19
5 urls : Object RegistryDirectory.java:371:46
6 url : URL RegistryDirectory.java:386:58
7 url : URL ScriptRouterFactory.java:41:29
8 url : URL ScriptRouterFactory.java:42:33
9 url : URL ScriptRouter.java:65:25
10 url : URL ScriptRouter.java:70:24
11 getRule(...) : String ScriptRouter.java:70:16
12 rule ScriptRouter.java:73:43
Path
Java Script Engine evaluate user input. ScriptRouter.java:73:24

Contribute your own queries and make some 💰

https://securitylab.github.com/get-involved

$184.000 bounties so far 🎉

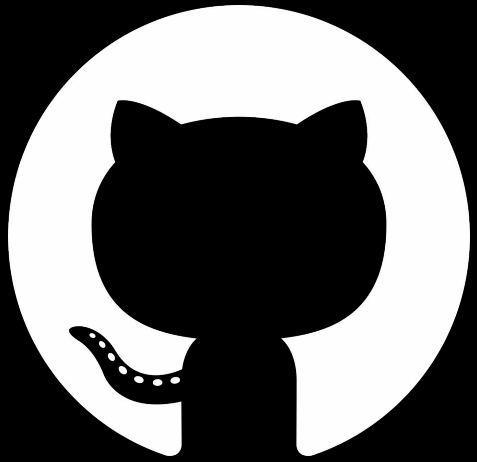
Thank you!



Reach out on twitter:

@pwntester

@ghsecuritylab



Tips & Tricks

Start small

- If you have a great idea test it first in a small synthetic example.
- This will avoid you a lot of head-scratching.
- Complex queries can take hours to finish.
  - Make sure your query finds what you are looking for in an example database.

Logic issues

- A good amount of issues come from trying to express what we want in logical terms.
- Doing this can be confusing.
- Make sure to undust your logic book and properly understand quantifiers, etc.

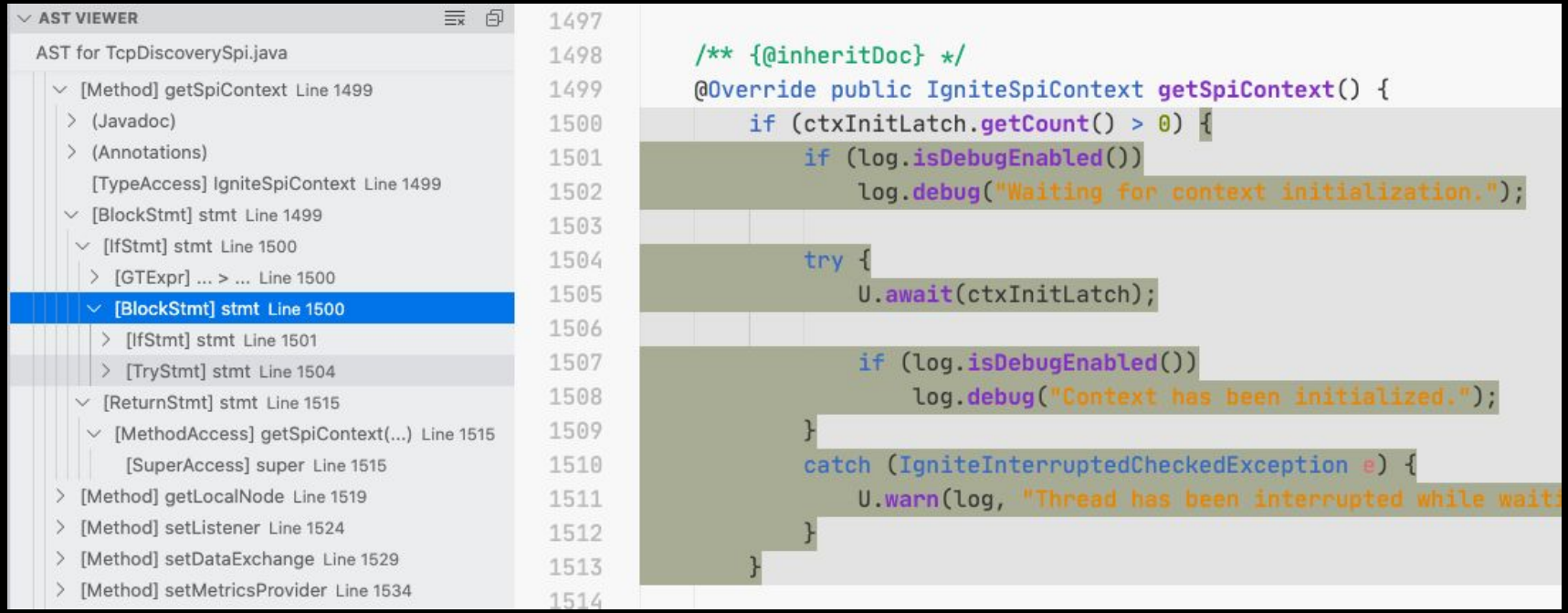
Debugging

- There is no “gdb” for codeql.
- Best tool you have is to break complex queries into small pieces.
- Each small piece can be executed in isolation.

AST Viewer

- The AST viewer allows you to see how codeql represents your code.
- This allows you to quickly identify the components involved in the pattern you are trying to query.
- Once you know the type in the AST you can import it in your CodeQl query.
- Support is limited to a handful of languages but soon it will work across all the supported languages.

AST Viewer


AST VIEWER
AST for TcpDiscoverySpi.java
[Method] getSpiContext Line 1499
(Javadoc)
(Annotations)
[TypeAccess] IgniteSpiContext Line 1499
[BlockStmt] stmt Line 1499
[IfStmt] stmt Line 1500
[GTExpr] ... > ... Line 1500
[BlockStmt] stmt Line 1500
[IfStmt] stmt Line 1501
[TryStmt] stmt Line 1504
[ReturnStmt] stmt Line 1515
[MethodAccess] getSpiContext(...) Line 1515
[SuperAccess] super Line 1515
[Method] getLocalNode Line 1519
[Method] setListener Line 1524
[Method] setDataExchange Line 1529
[Method] setMetricsProvider Line 1534
1497
1498 /** {@inheritDoc} */
1499 @Override public IgniteSpiContext getSpiContext() {
1500 if (ctxInitLatch.getCount() > 0) {
1501 if (log.isDebugEnabled())
1502 log.debug("Waiting for context initialization.");
1503
1504 try {
1505 U.await(ctxInitLatch);
1506
1507 if (log.isDebugEnabled())
1508 log.debug("Context has been initialized.");
1509 }
1510 catch (IgniteInterruptedCheckedException e) {
1511 U.warn(log, "Thread has been interrupted while wait
1512 }
1513 }
1514