

CS 4530

Software Engineering

Lecture 14 - Analysis/Refactoring; Covey.Town Internals

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Zoom Mechanics

- Recording: This meeting is being recorded
- If you feel comfortable having your camera on, please do so! If not: a photo?
- I can see the zoom chat while lecturing, slack while you're in breakout rooms
- If you have a question or comment, please either:
 - “Raise hand” - I will call on you
 - Write “Q: <my question>” in chat - I will answer your question, and might mention your name and ask you a follow-up to make sure your question is addressed
 - Write “SQ: <my question>” in chat - I will answer your question, and not mention your name or expect you to respond verbally



Today's Agenda

Administrative:

Project Plan due tomorrow!

HW4 due next Friday

Today's session:

Static analysis + refactoring review + discussion

Static Analysis Review

- Find likely bugs, but programming practices (eslint + LGTM/codeql)
- Extremely difficult to *prove* that programs are correct
- This is an enormous research area

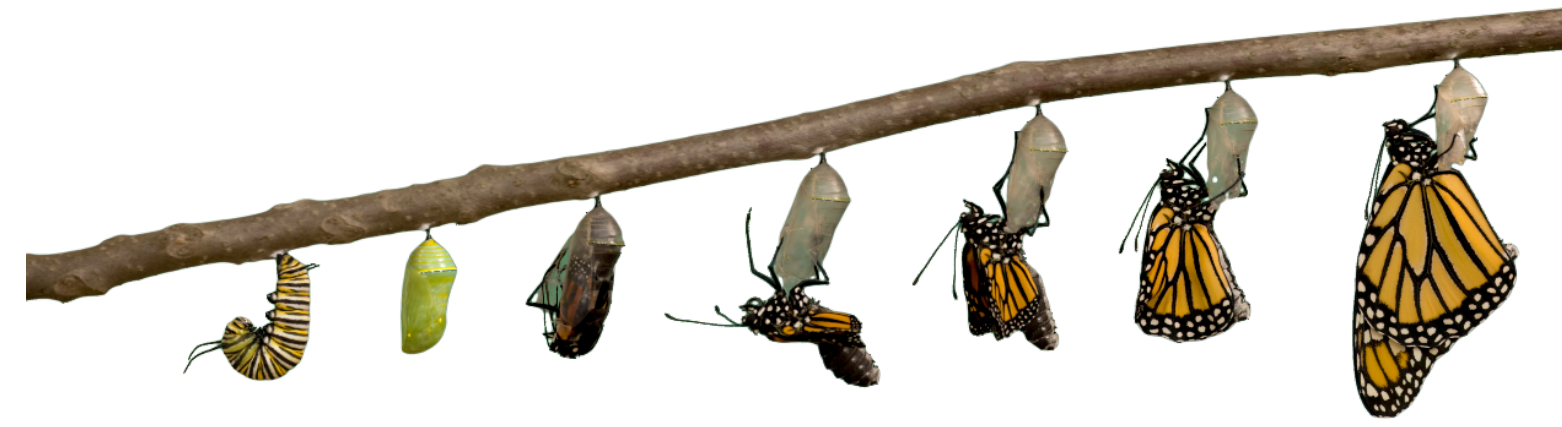
Refactoring

Martin Fowler



“Any fool can write code that a computer can understand. Good programmers write code that humans can understand.”

Why Refactor?



- requirements have changed, and a different design is needed
- design needs to be more flexible (so new features can be added)
 - design patterns are often a target for refactoring
- address sloppiness by programmers

Example Refactoring

Consolidating duplicate conditional fragments

Original Code

```
if (isSpecialDeal()) {  
    total = price * 0.95;  
    send()  
} else {  
    total = price * 0.98;  
    send()  
}
```

Refactored Code

```
if (isSpecialDeal()) {  
    total = price * 0.95;  
} else {  
    total = price * 0.98;  
}  
send()
```

Observations

- **small incremental steps** that preserve program behavior
- most steps are so simple that they can be **automated**
 - automation limited in complex cases
- refactoring does not always proceed “in a straight line”
 - sometimes, undo a step you did earlier...
 - ...when you have insights for a better design

When to refactor?

Refactoring is incremental redesign

- Acknowledge that it will be difficult to get design right the first time
- When adding new functionality, fixing a bug, doing code review, or any time
- Refactoring evolves design in increments
- Refactoring reduces technical debt
- What do you refactor?

Code Smells

Mysterious Name

“We may fantasize about being International Men of Mystery, but our code needs to be mundane and clear”

- Martin Fowler on “Mysterious Name”

Code Smells

Shotgun Surgery

“When the changes are all over the place, they are hard to find, and it’s easy to miss an important change.”

- Martin Fowler on “Shotgun Surgery”

Code Smells

A complete list (links to book!)

[Mysterious Name](#)

[Duplicated Code](#)

[Long Function](#)

[Long Parameter List](#)

[Global Data](#)

[Mutable Data](#)

[Divergent Change](#)

[Shotgun Surgery](#)

[Feature Envy](#)

[Data Clumps](#)

[Primitive Obsession](#)

[Repeated Switches](#)

[Loops](#)

[Lazy Element](#)

[Speculative Generality](#)

[Temporary Field](#)

[Message Chains](#)

[Middle Man](#)

[Insider Trading](#)

[Large Class](#)

[Alternative Classes with Different Interfaces](#)

[Data Class](#)

[Refused Bequest](#)

“Local” Refactorings

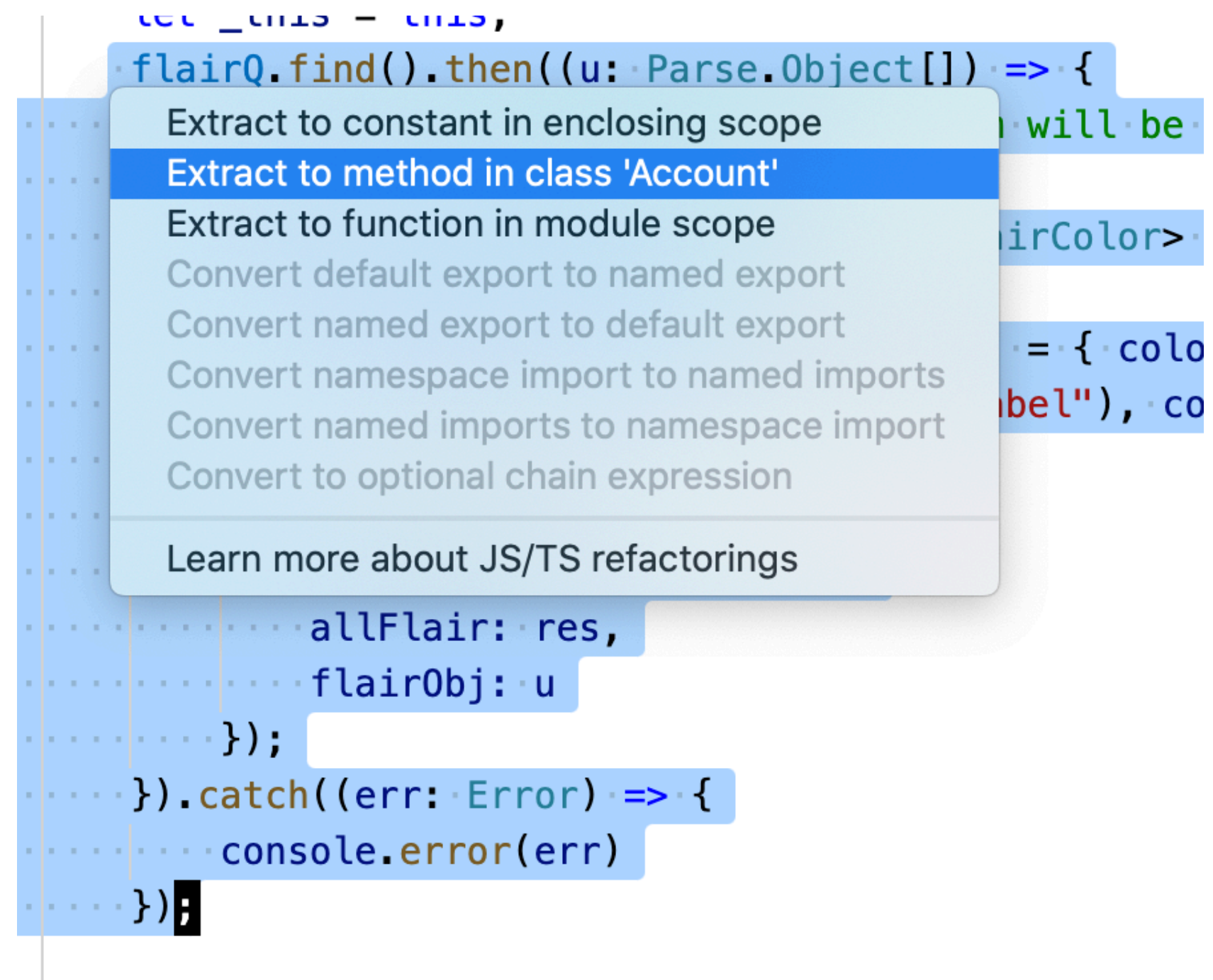
| | |
|--|---|
| Rename | rename variables, fields methods, classes, packages provide better intuition for the renamed element's purpose |
| Extract Method | extract statements into a new method enables reuse; avoid cut-and-paste programming improve readability |
| Inline Method | replace a method call with the method's body often useful as intermediate step |
| Extract Local | introduce a new local variable for a designated expression |
| Inline Local | replace a local variable with the expression that defines its value |
| Change Method Signature | reorder a method's parameters |
| Encapsulate Field | introduce getter/setter methods |
| Convert Local Variable to Field | convert local variable to field sometimes useful to enable application of Extract Method |

Type-Related Refactorings

| | |
|-------------------------------------|--|
| Generalize Declared Type | replace the type of a declaration with a more general type |
| Extract Interface | create a new interface, and update declarations to use it where possible |
| Pull Up Members | move methods and fields to a superclass |
| Infer Generic Type Arguments | infer type arguments for “raw” uses of generic types |

Automated Refactorings in VSC

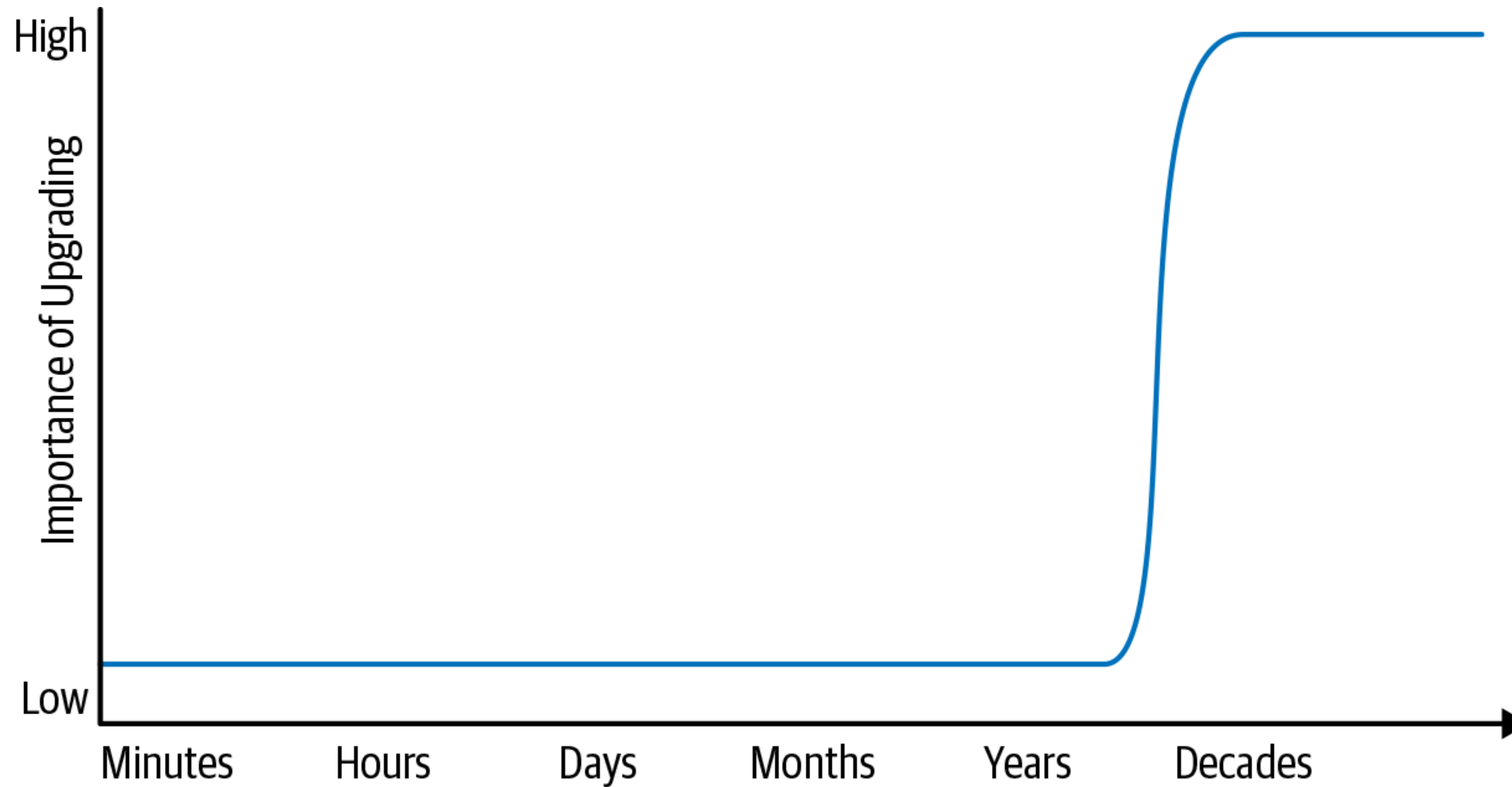
```
let _this = this,
    flairQ.find().then((u: Parse.Object[]) => {
    ...
    ... will be
    ... irColor>
    ... = { colo
    ... bel"), co
    ...
    ... allFlair: res,
    ... flairObj: u
    ... });
    ... }).catch((err: Error) => {
    ... console.error(err)
    ... });
```



Refactoring Risks

- Developer time is valuable: is this the best use of time *today*?
- Despite best intentions, may not be safe
- Potential for version control conflicts

Technical Debt

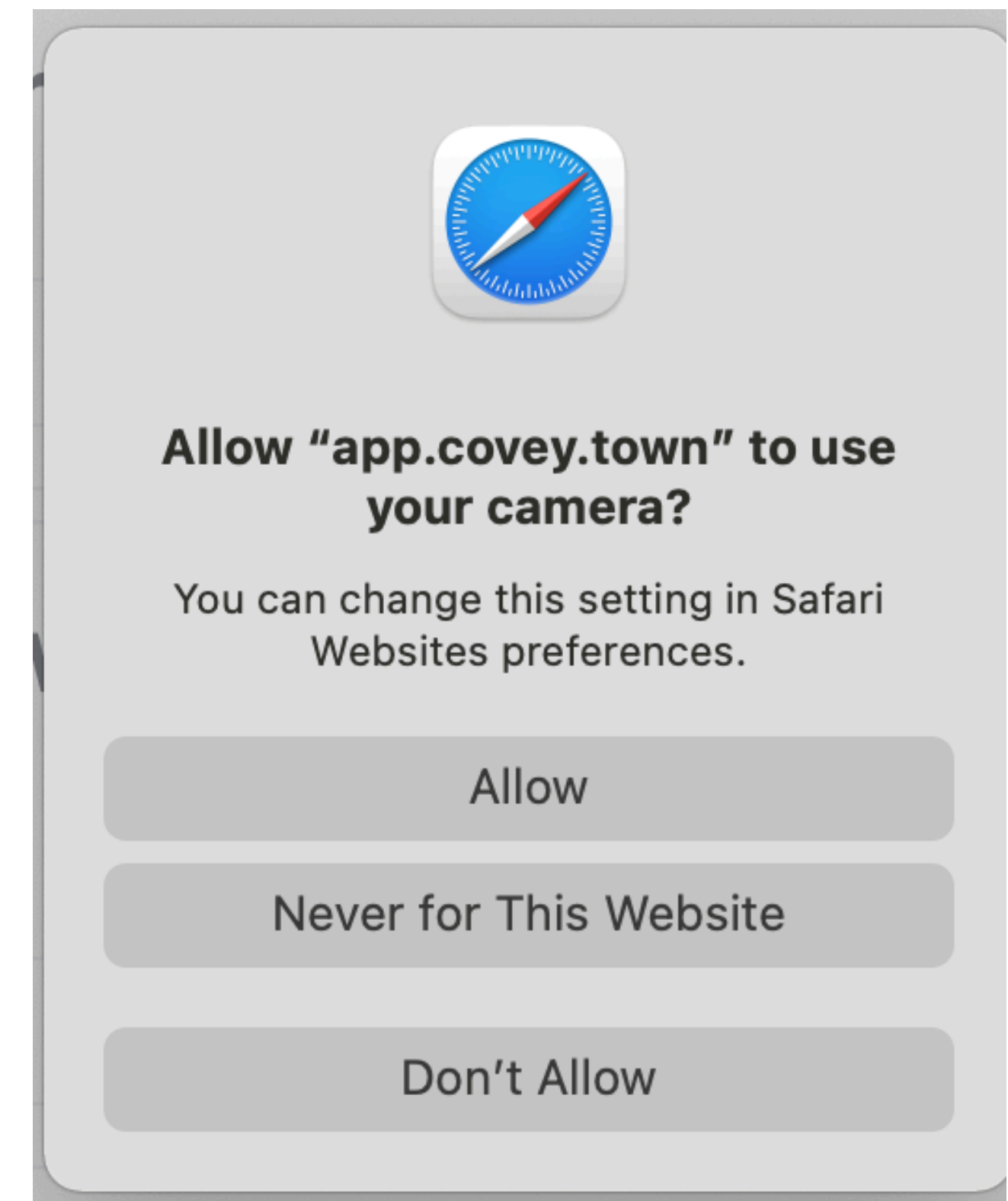


Life span and the importance of upgrades

Web-Based Video Chat Apps

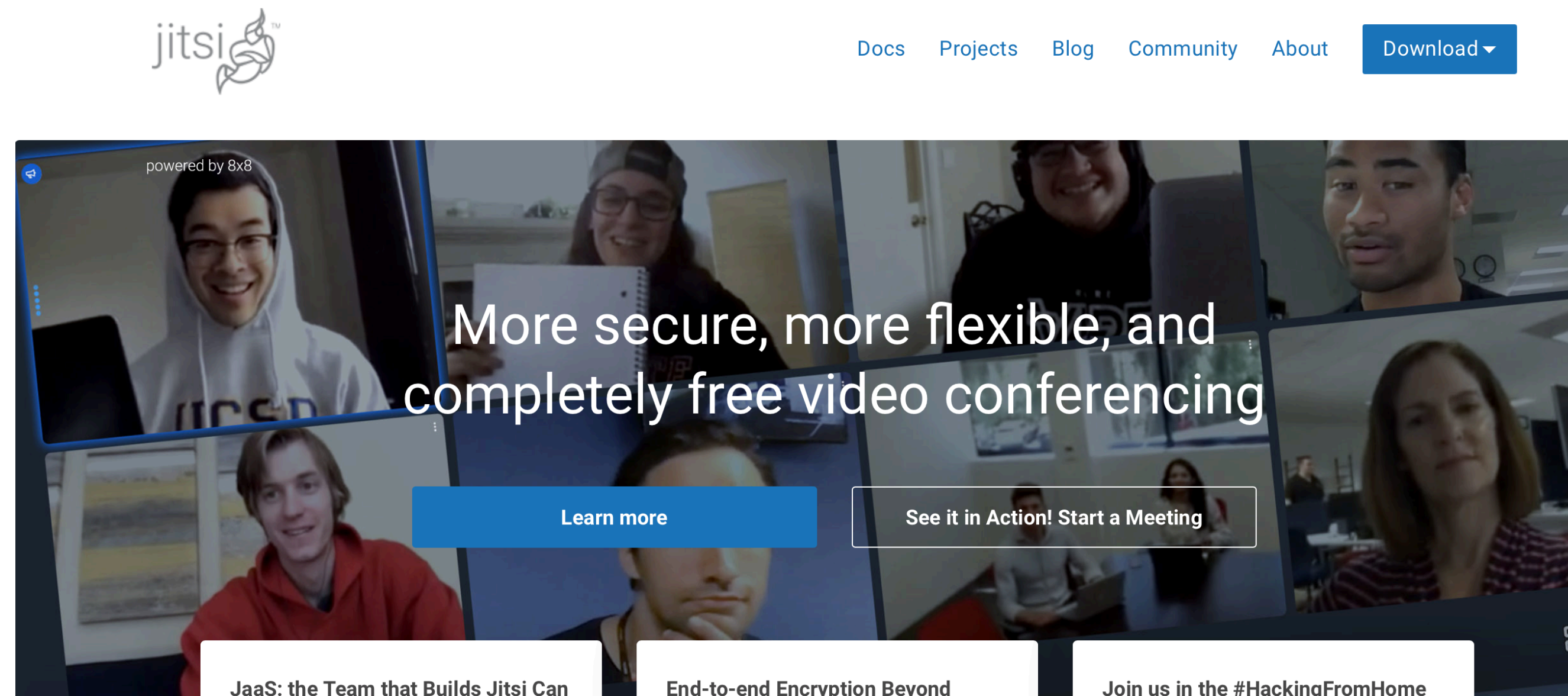
WebRTC, a standard for:

- Capturing camera + microphone with JS
- Transporting real-time audio + video between browsers
- Displaying real-time audio + video with JS
- Everything that does video chat in your browser without a plugin (everything now?) uses WebRTC



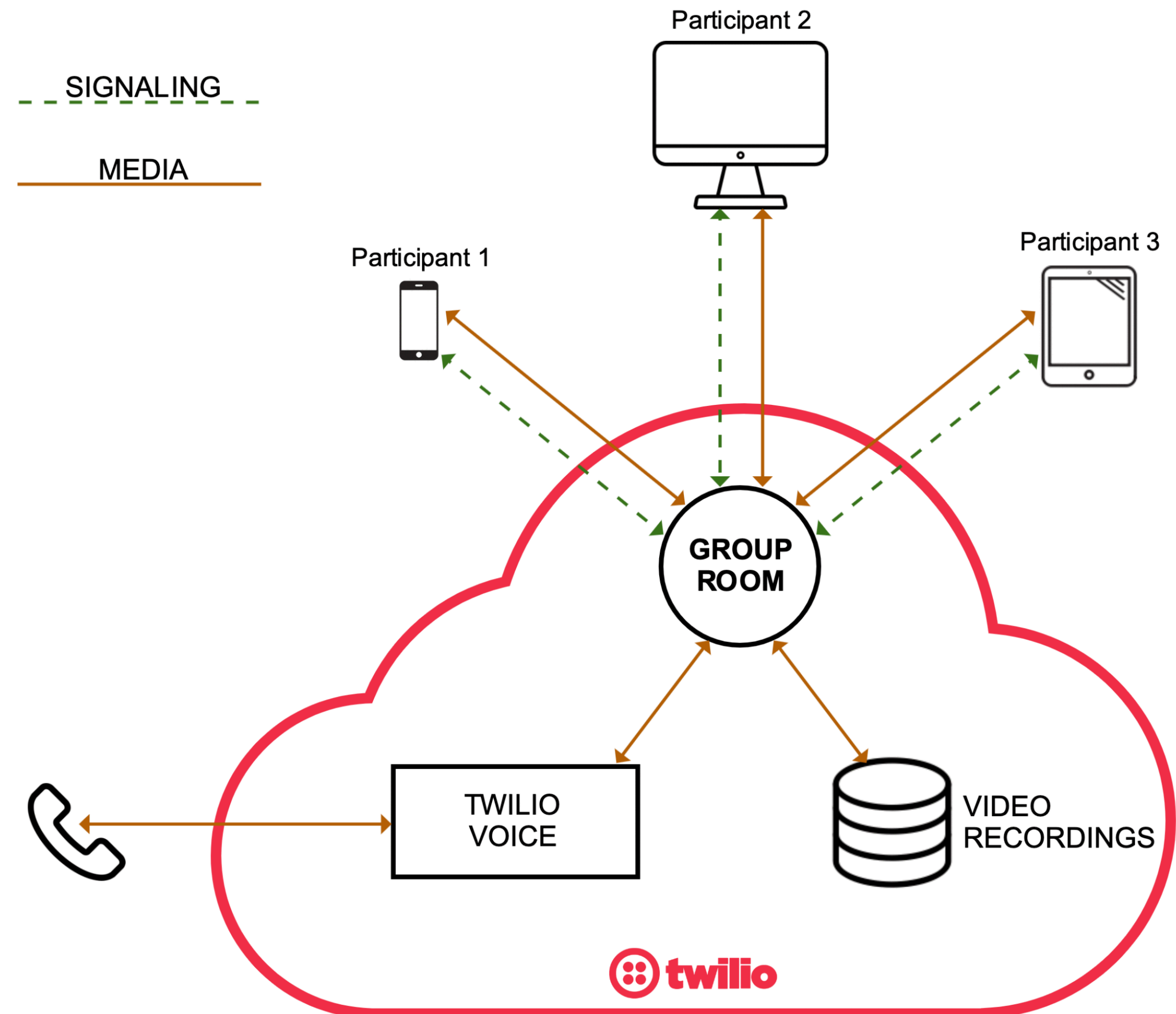
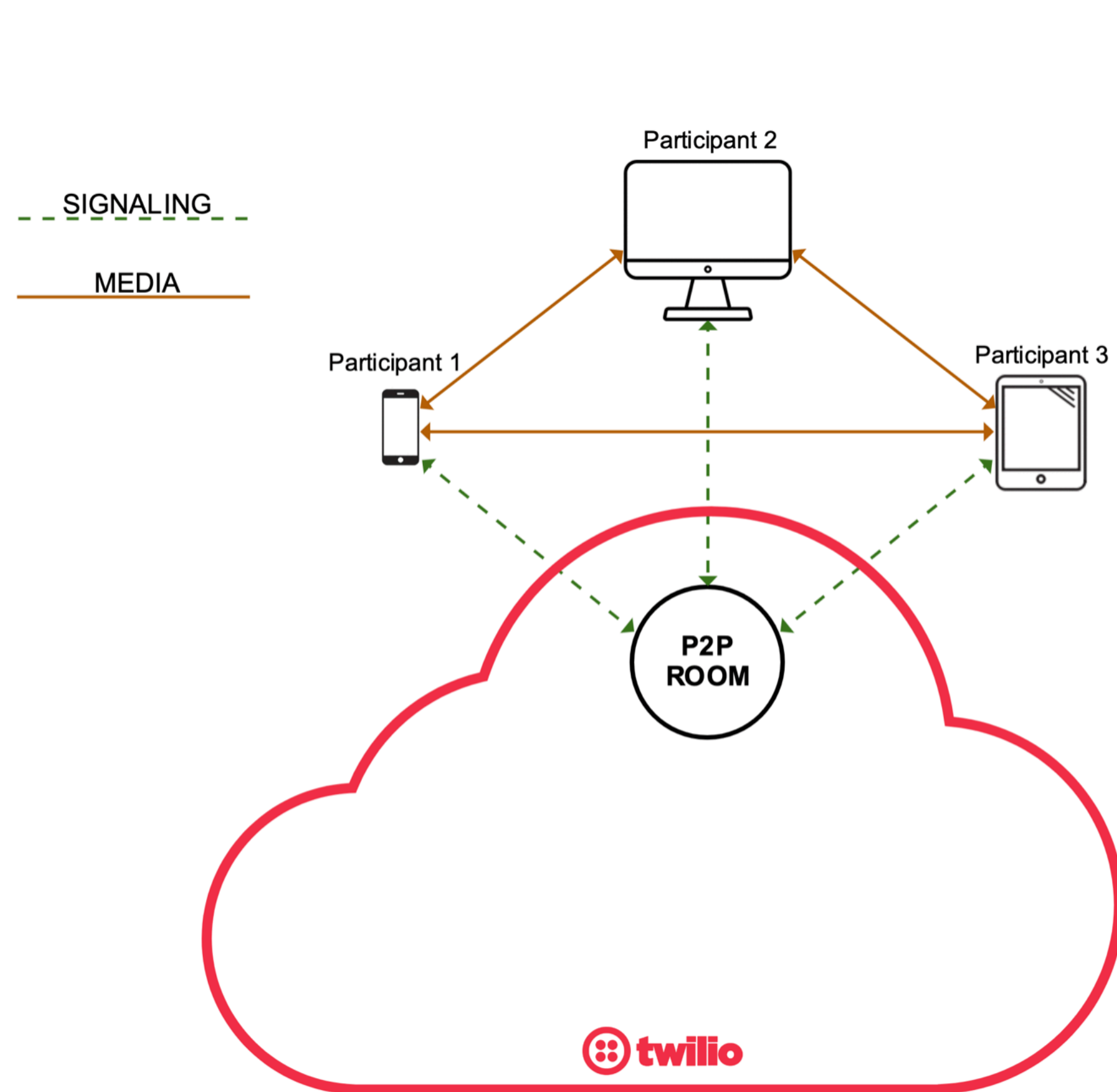
Other WebRTC services you might use

- Vonage - Like Twilio, but support calls with 1000's of participants, livestream integrations - <https://www.vonage.com/>
- Jitsi - Open source infrastructure for WebRTC, support calls with 1000's of participants, rich meeting UI <https://jitsi.org>



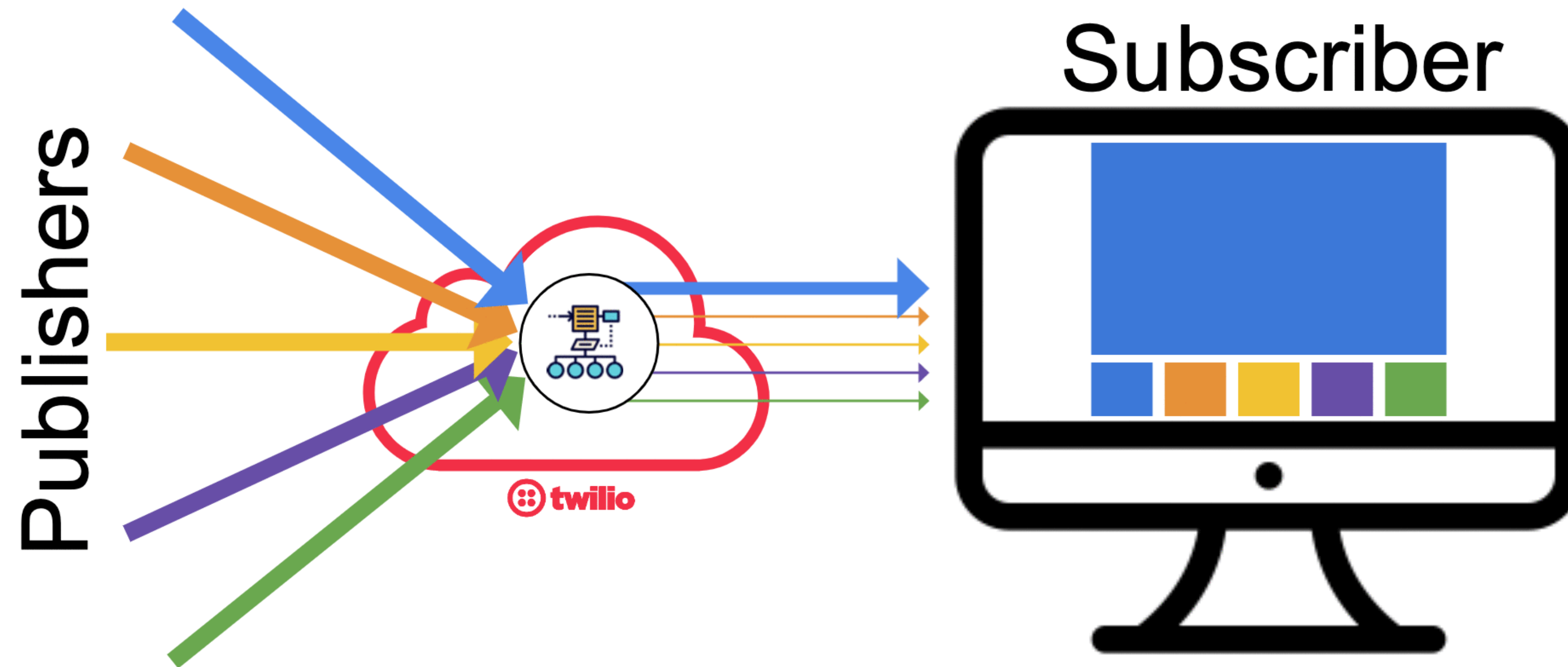
Twilio Programmable Video

Two room “topologies”: P2P + Group

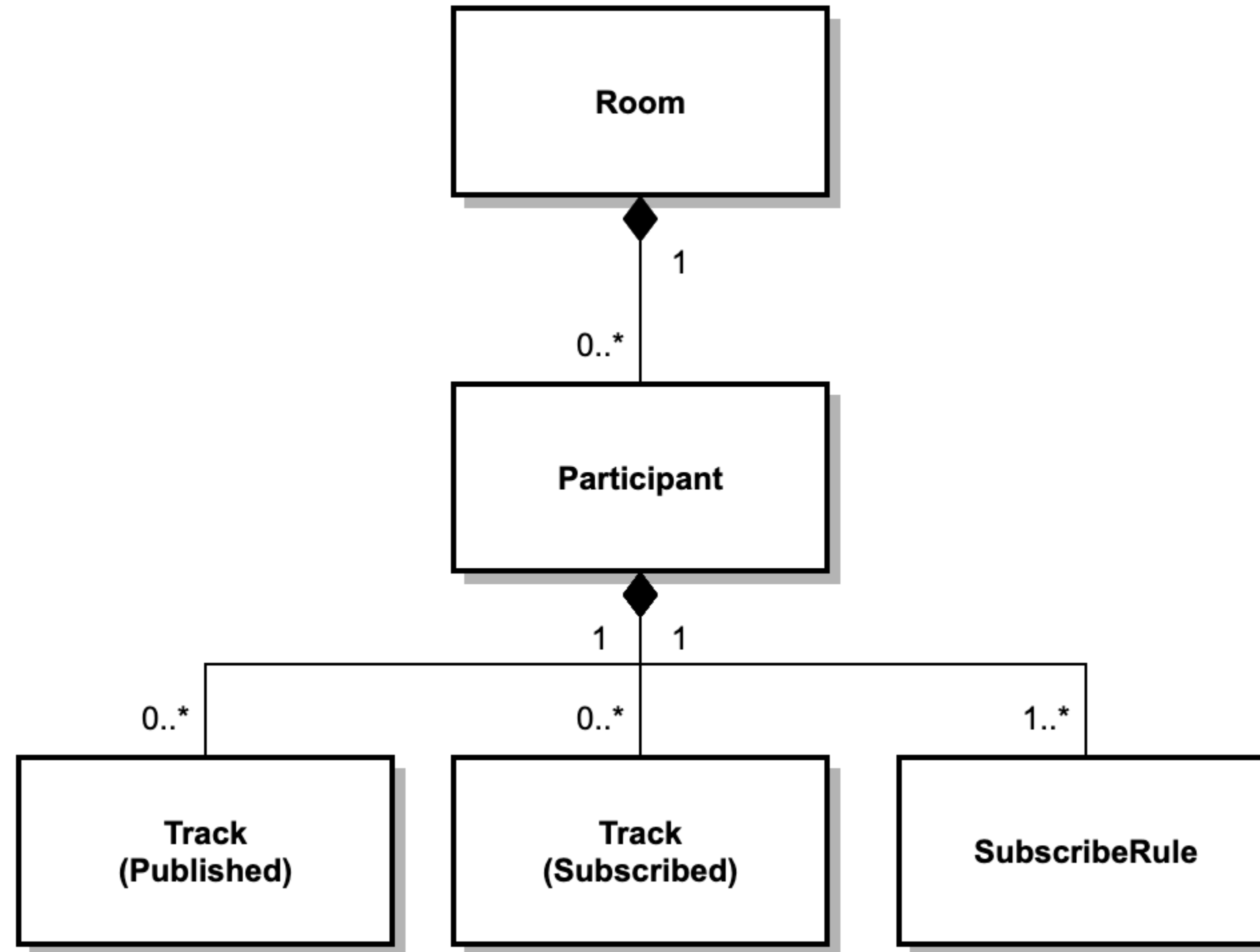


Twilio Programmable Video

Publishers + Subscribers

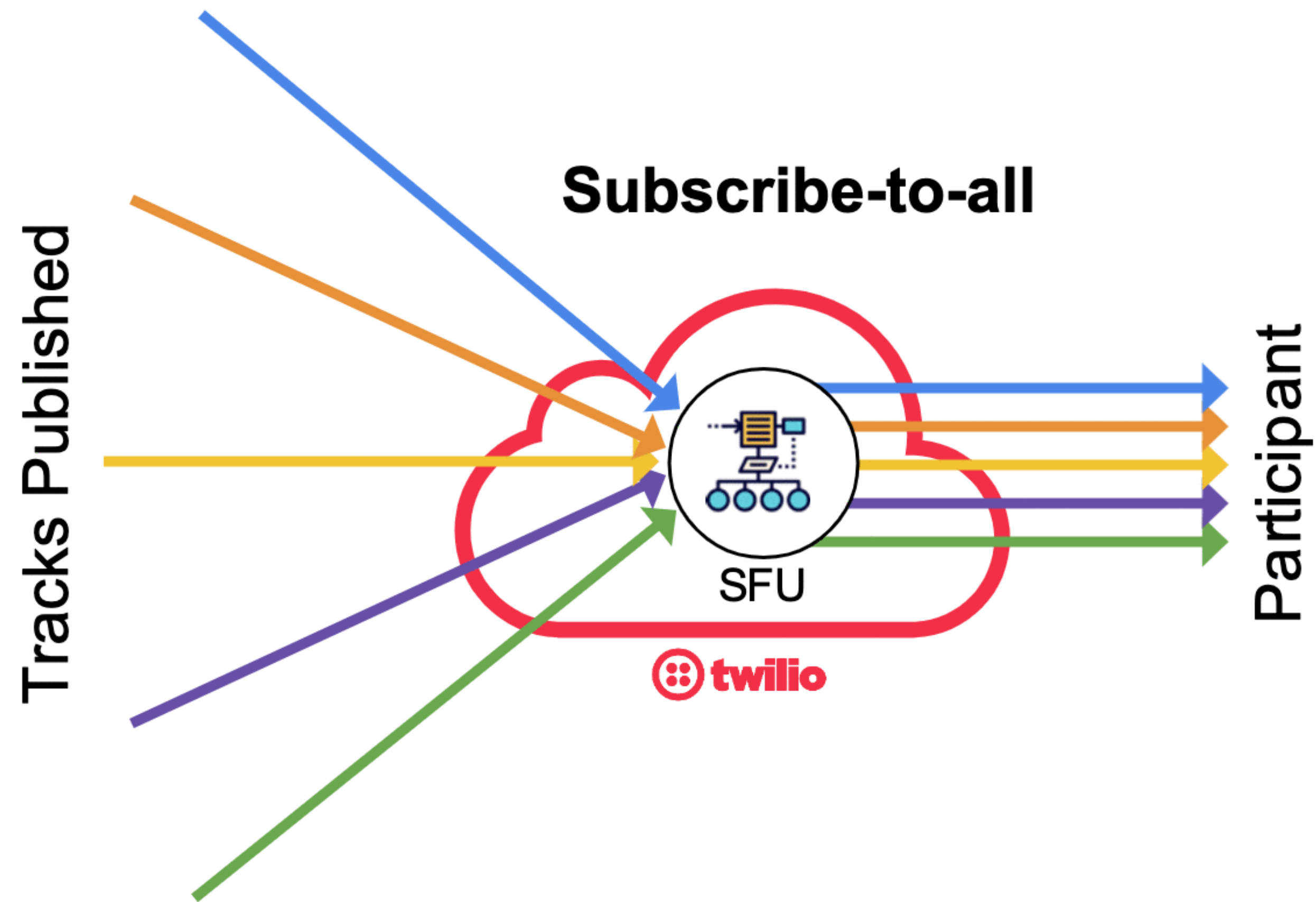


Twilio Abstractions



Twilio Programmable Video

Tracks & Subscriptions



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