
TMT Software Architecture

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ThoughtWorks



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We work with people and organizations who have ambitious missions

We are focused on helping our industry improve.

We are strong believers in the power of software and technology as tools for social change.

6000+

Employees

14

Countries

40

Offices



- World's largest optical telescope
- Operational in 2027!
- Mauna Kea, Hawaii
- Five countries collaborating
 - USA
 - Canada
 - China
 - Japan
 - India

<https://www.tmt.org/>



Control System Middleware (CSW)

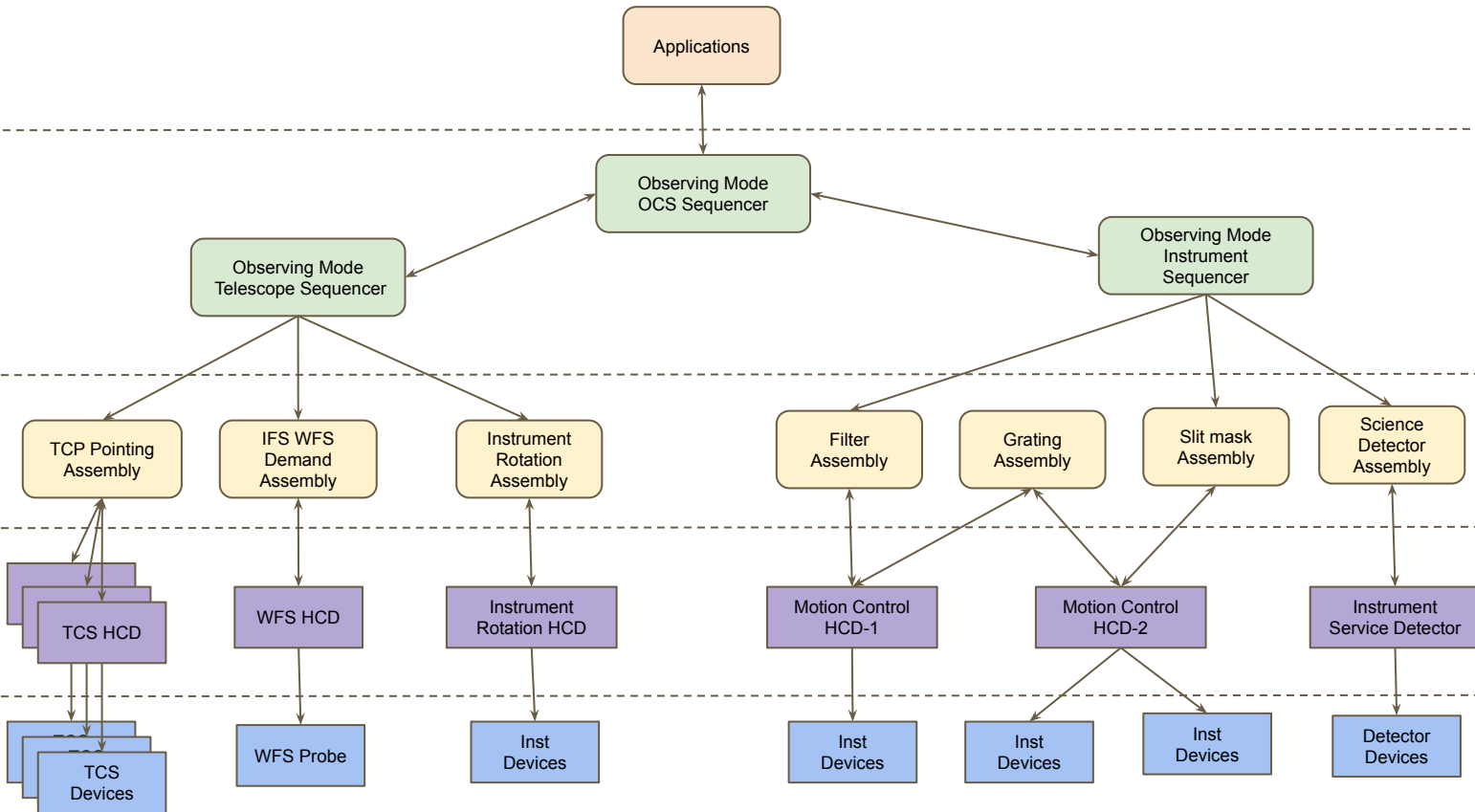
4: Monitoring and Control

3: Sequencing Layer

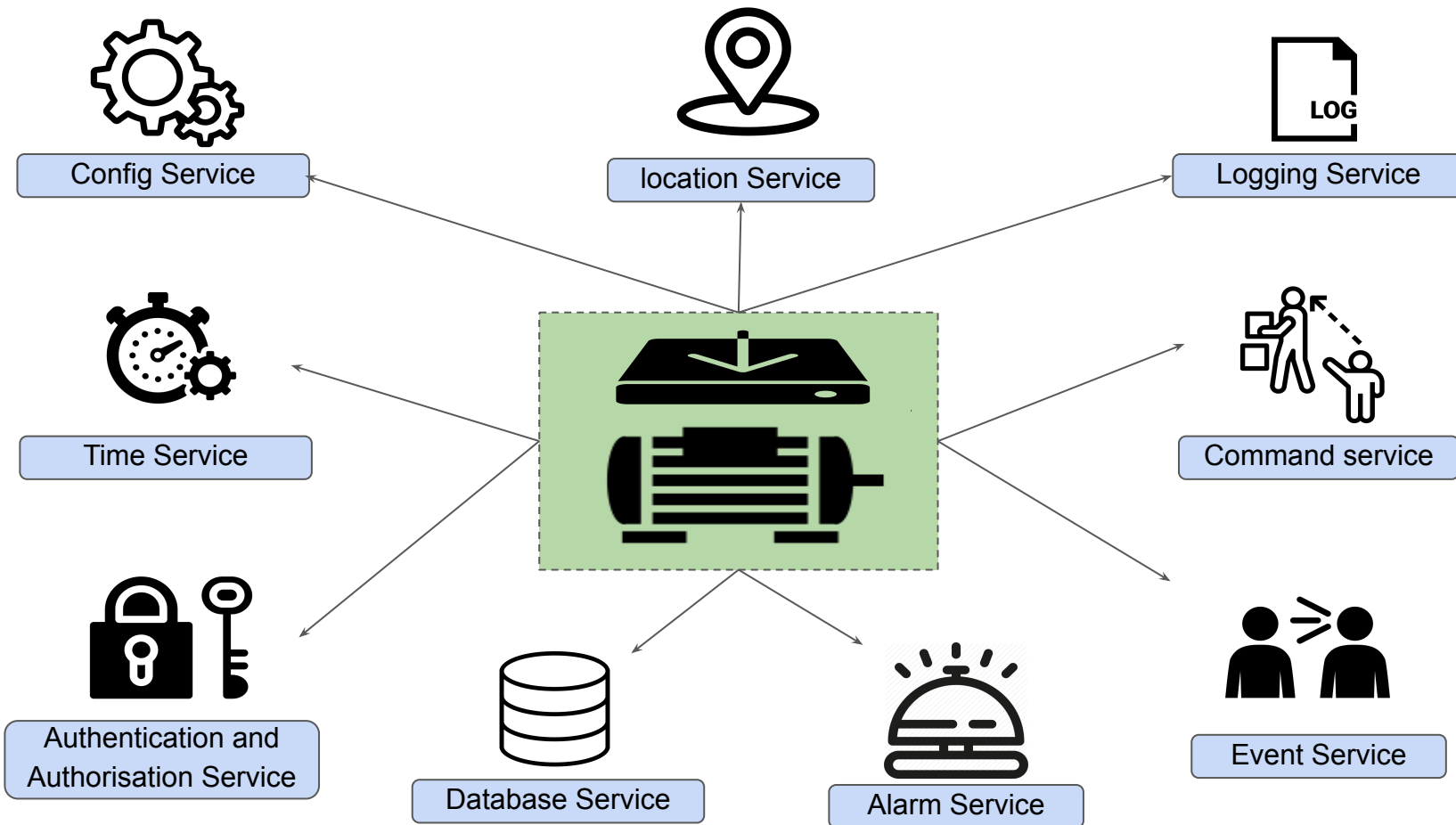
2: Assembly Layer

1: Hardware Control Layer

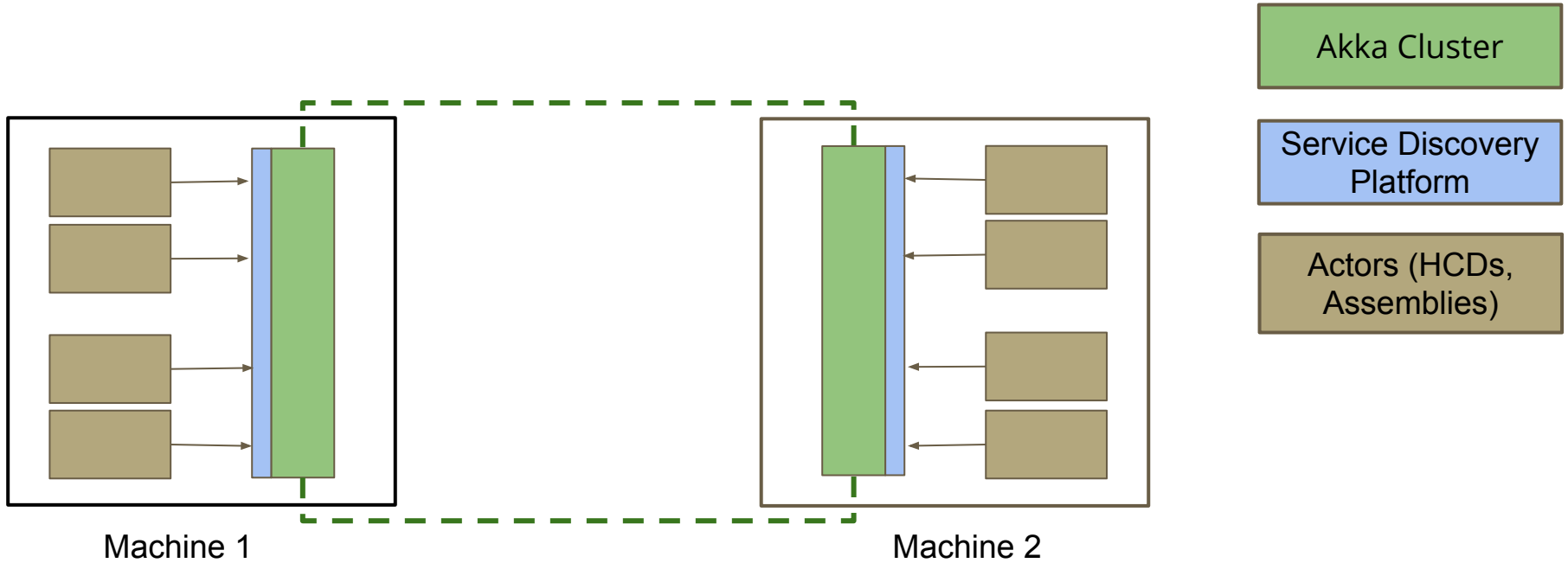
0: Observatory Hardware



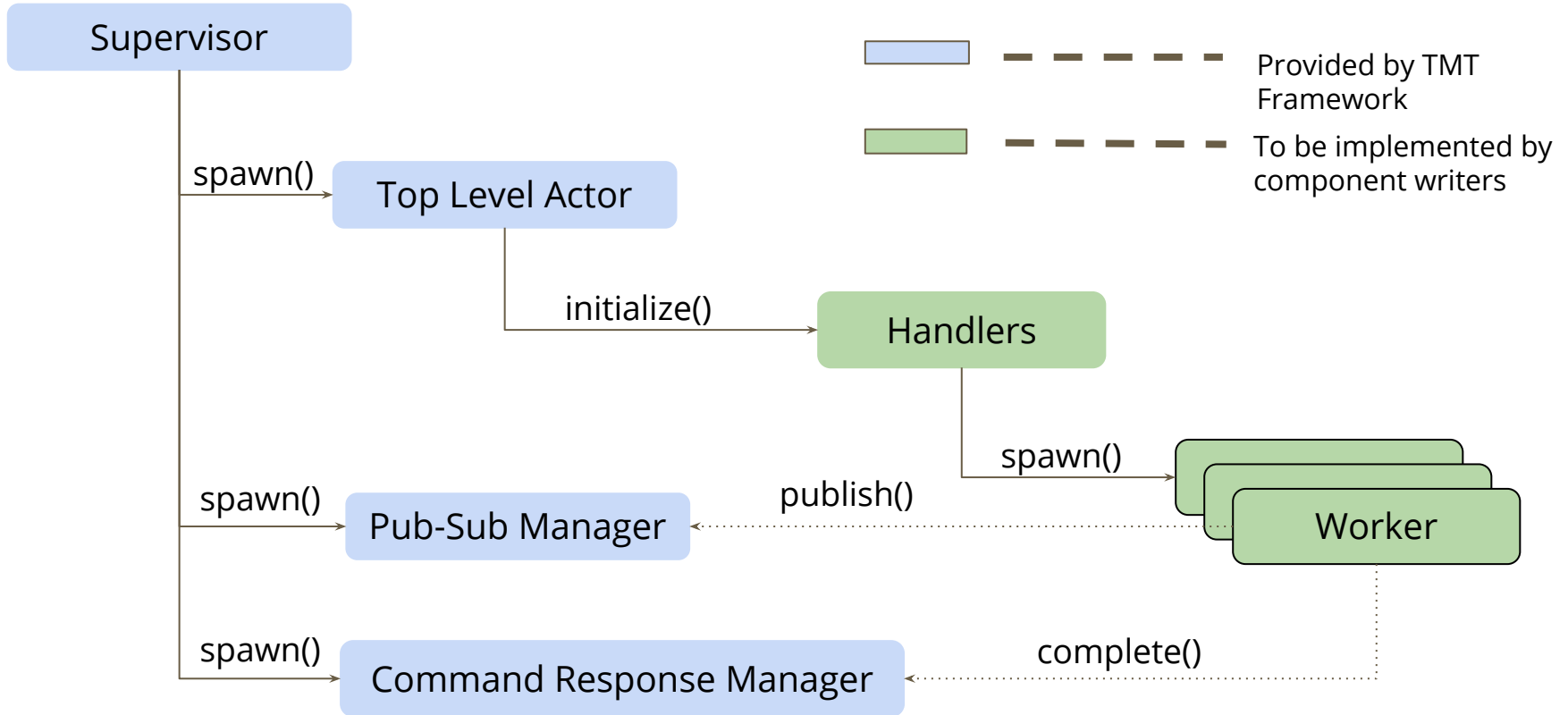
CSW Middleware Services



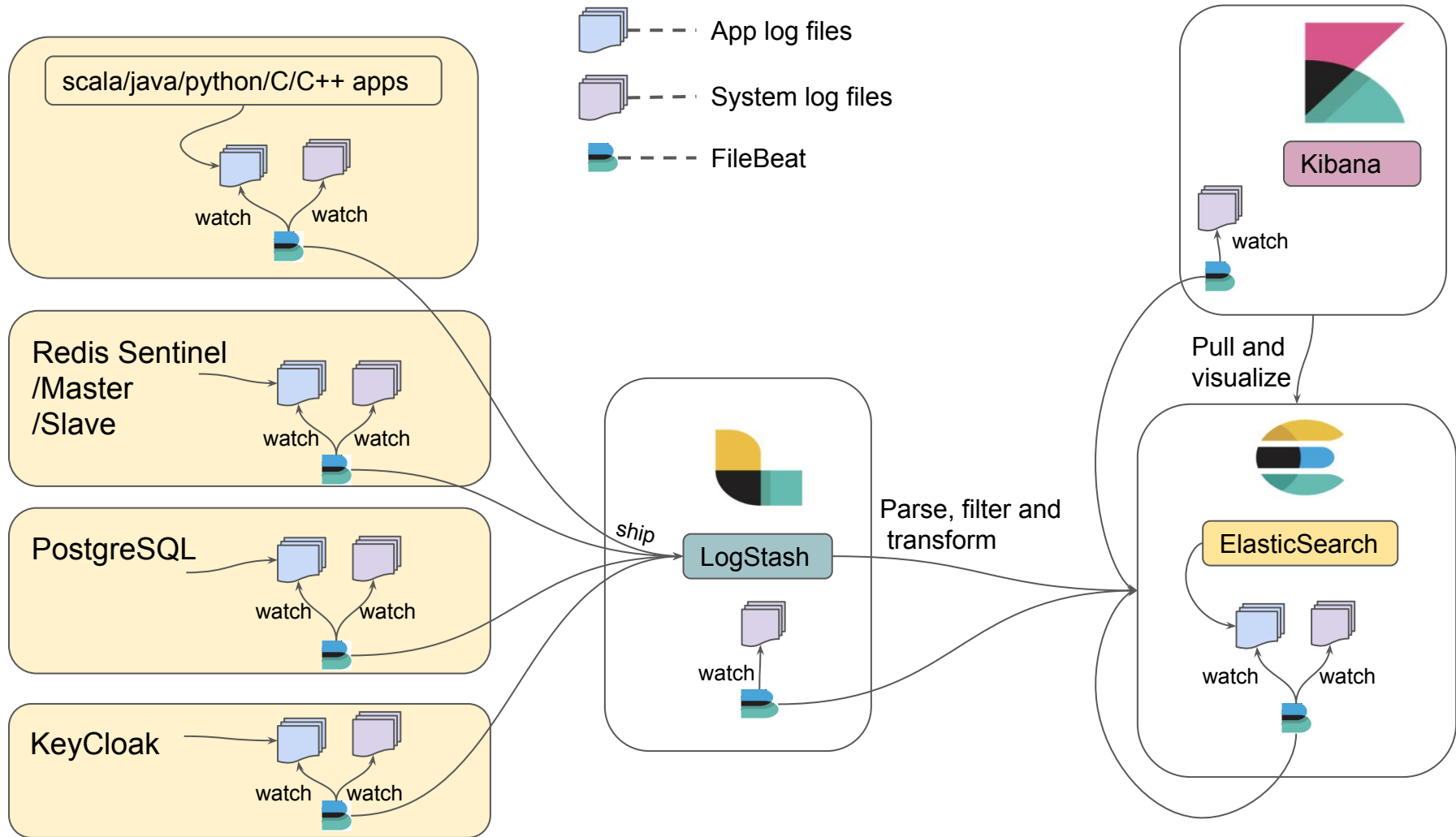
Deployment and Discovery



Anatomy of a TMT Component

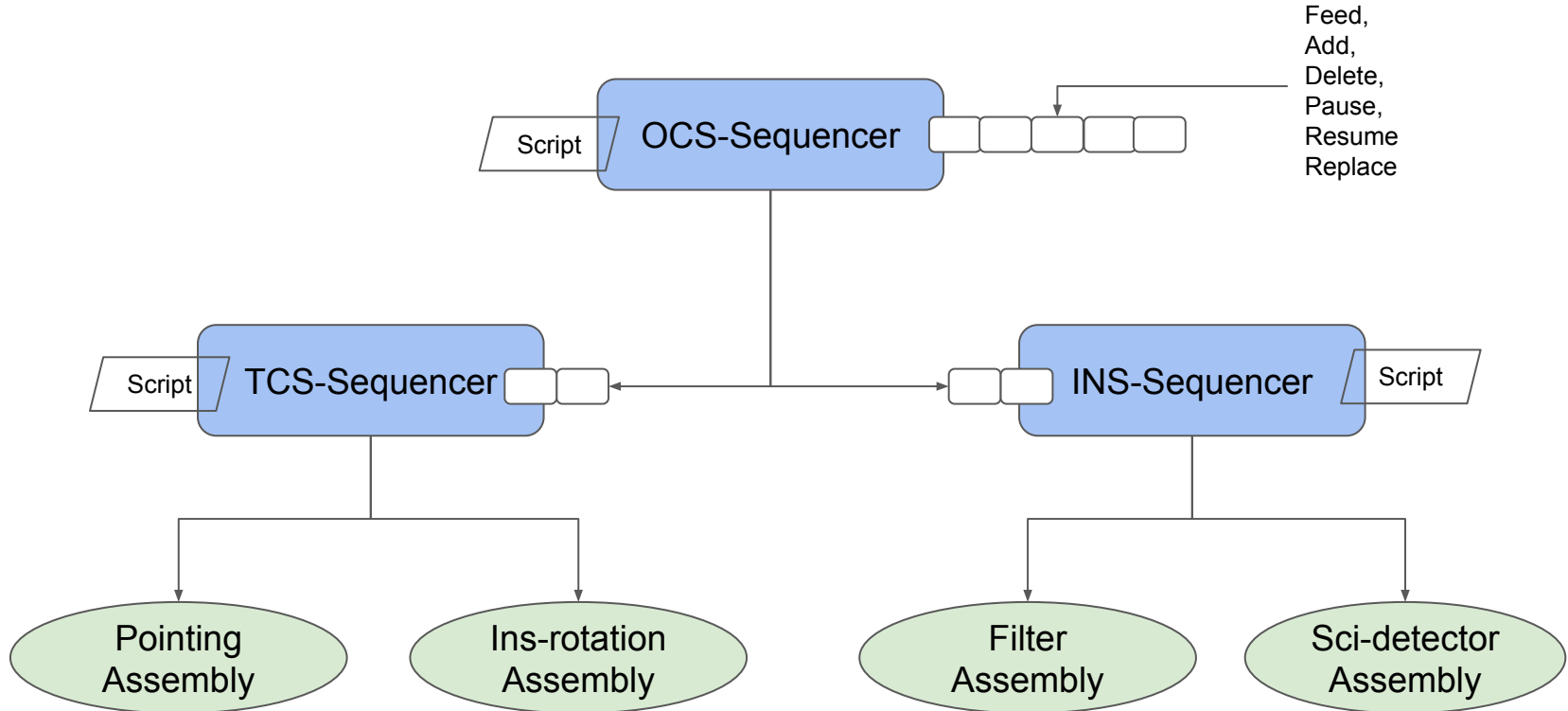


Log Aggregation

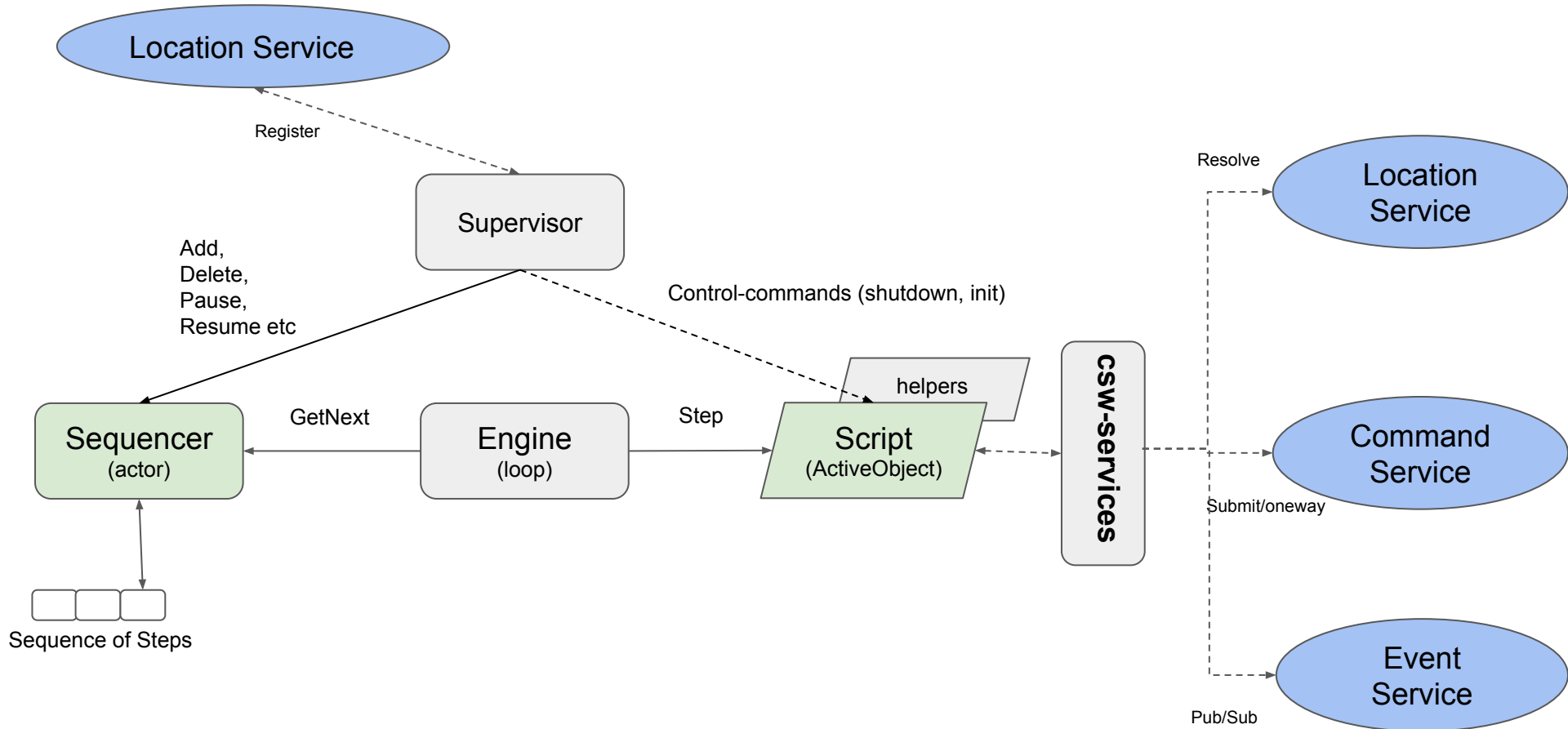


Executive Software (ESW)

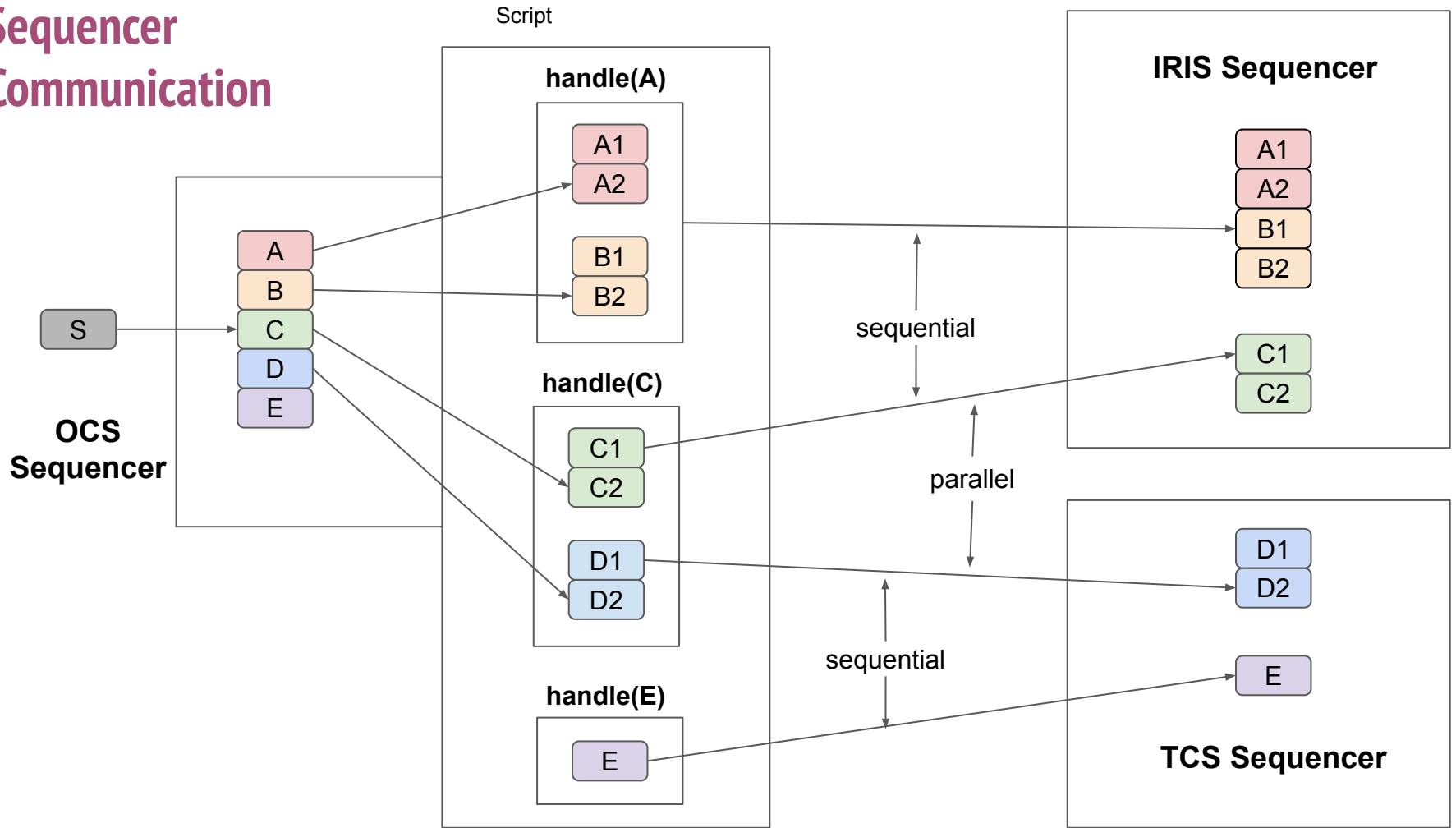
ESW Sequencer Hierarchy



Sequence Component



Sequencer Communication



Finished

InFlight

Pending



Step with Id A

Sequence

Breakpoint

Add: J, K

Delete: G, I

Prepend: G, I

Delete: H, K

InsertAfter(G): H, K

Reset

Add: G, H, I, K

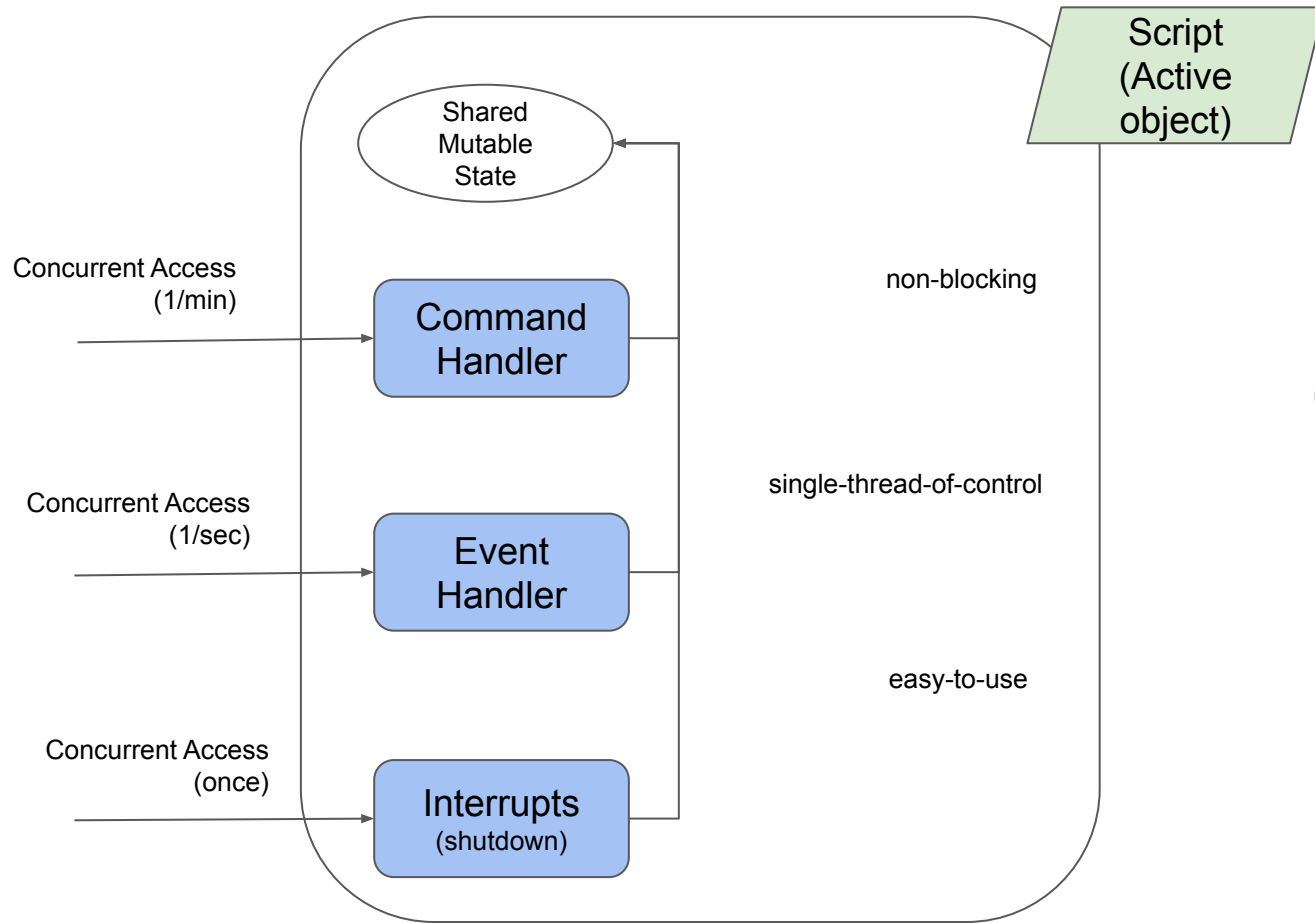
AddBreakpoints: H, K

RemoveBreakpoints: H, K

Pause

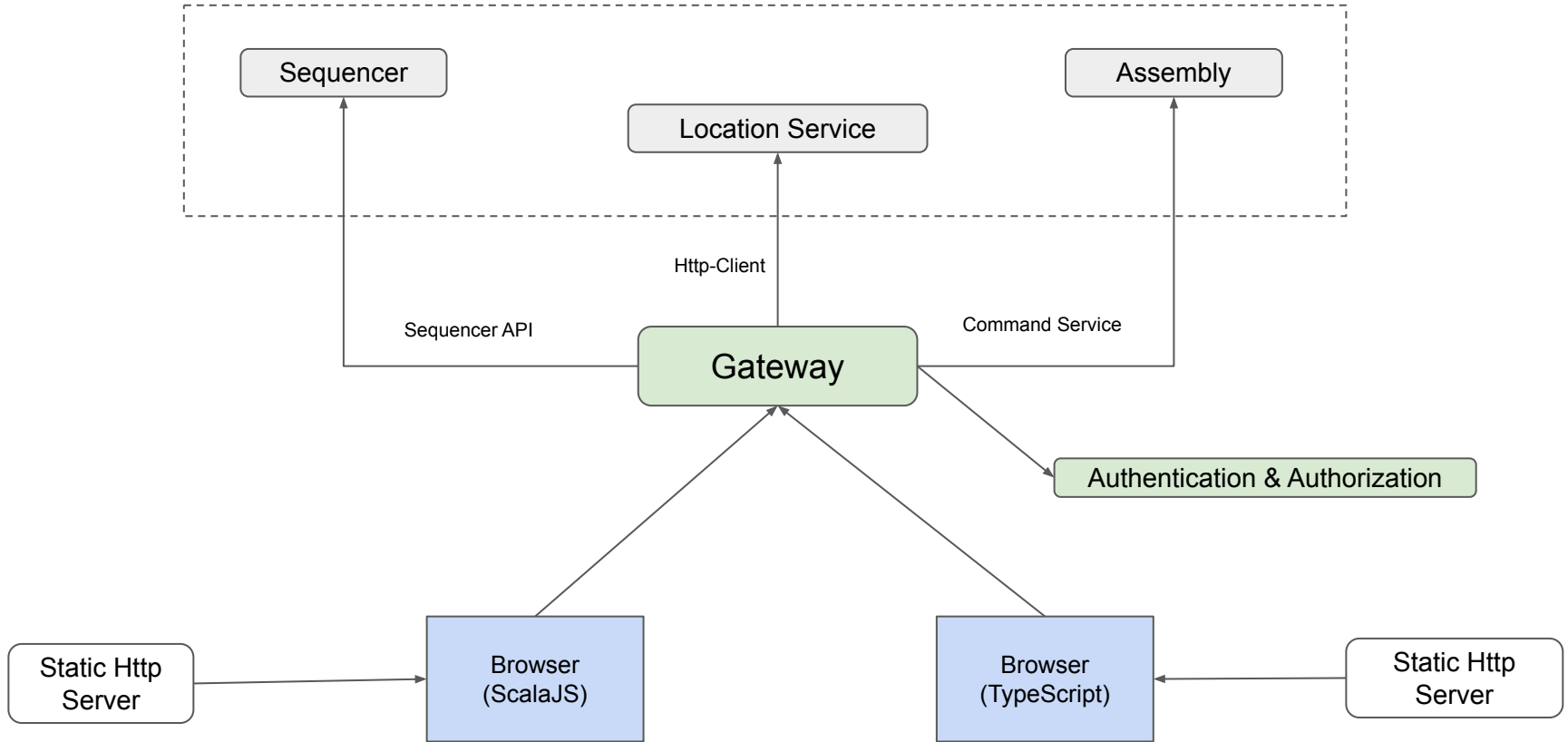
Resume

Step-level Operations

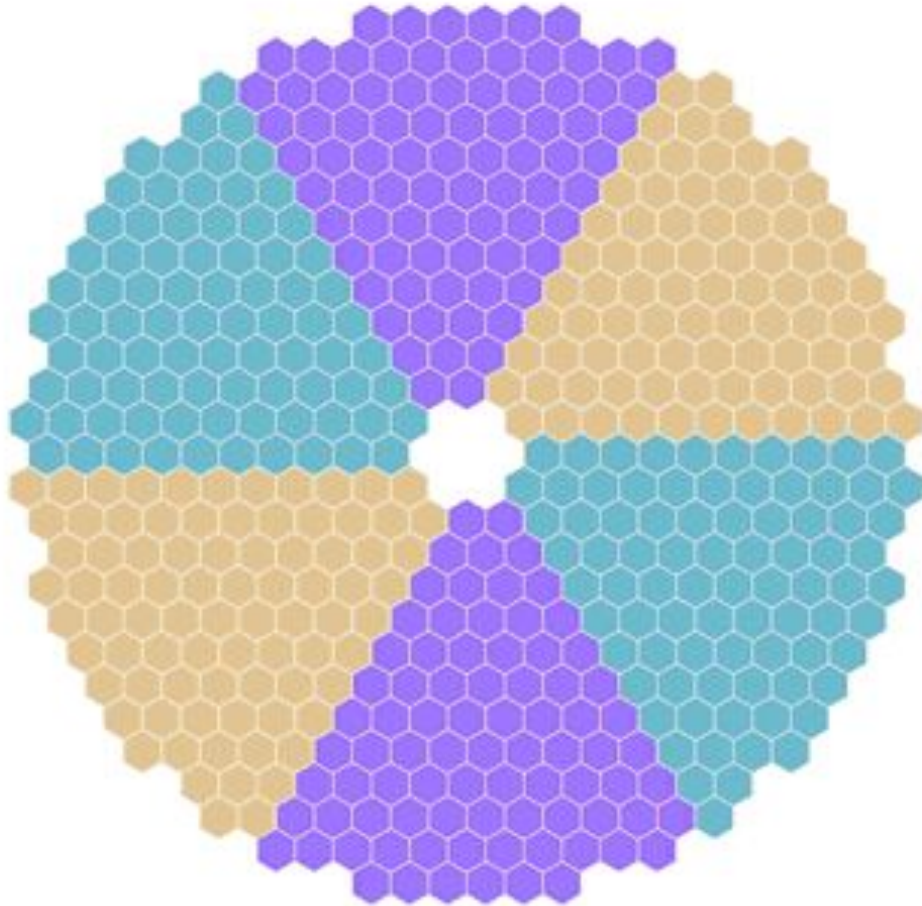


Concurrency in Scripts

UI Gateway

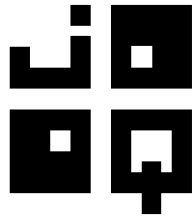


Mirror Honeycomb



```
Elements Console  
100  
(13, 4, 5, (254, 384))  
(13, 5, 6, (381, 88))  
(13, 5, 1, (488, 88))  
(13, 5, 2, (436, 88))  
(13, 5, 3, (464, 88))  
(13, 5, 4, (492, 88))  
(13, 5, 5, (519, 88))  
(13, 6, 6, (686, 384))  
(13, 6, 1, (699, 288))  
(13, 6, 2, (713, 232))  
(13, 6, 3, (727, 256))  
(13, 6, 4, (741, 288))  
(13, 6, 5, (755, 384))  
① Position(100, 100, 100)  
Position(8, 9, 2)  
Position(5, 3, 6)  
① Position(9, 1, 6)  
① Position(100, 100, 100)  
① Position(9, 1, 6)  
① Position(100, 100, 100)  
Position(8, 9, 2)  
① Position(100, 100, 100)  
Position(8, 9, 2)  
① Position(9, 1, 6)  
Position(1, 6, 7)  
Position(9, 1, 6)  
Position(1, 6, 4)  
Position(3, 4, 6)  
Position(9, 1, 6)  
Position(8, 9, 2)  
Position(3, 5, 8)  
① Position(9, 1, 6)  
Position(2, 4, 9)  
Position(100, 100, 100)  
Position(9, 1, 6)
```

Tech Stack



Team

ThoughtWorks, Pune

- Mushtaq Ahmed
- Unmesh Joshi
- Pritam Kadam
- Dolly Gyanchandani
- Bilal Fazlani
- Saloni Vithalani
- Shubham Jaybhaye
- Chhaya Yadav
- Gunjan Shukla
- Santosh Mahale
- Puneet Patwari
- Poorva Gokhale

TMT, Pasadena

- Francisco Delgado
- Kim Gillies
- Allan Brighton
- Jason Weiss

IIA, Bangalore

- Rajalakshmi Karthik
- Annapurni Subramaniam

Thank you

<https://tmtsoftware.github.io/csw/>

<https://github.com/tmtsoftware/csw>

<https://github.com/tmtsoftware/esw-prototype>