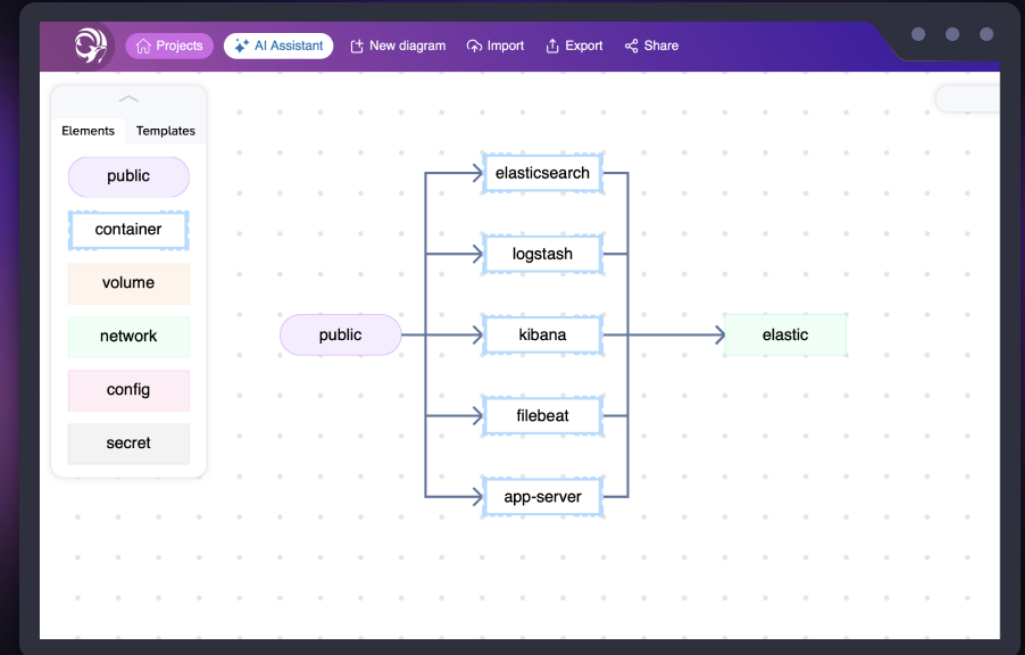


Collaborative Modelling capabilities in Orca with CRDTs

Matthew Weidner, Javier Centeno & Pedro J. Molina

METADeV



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1. Use cases
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4. CRDTs
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ProxyHands

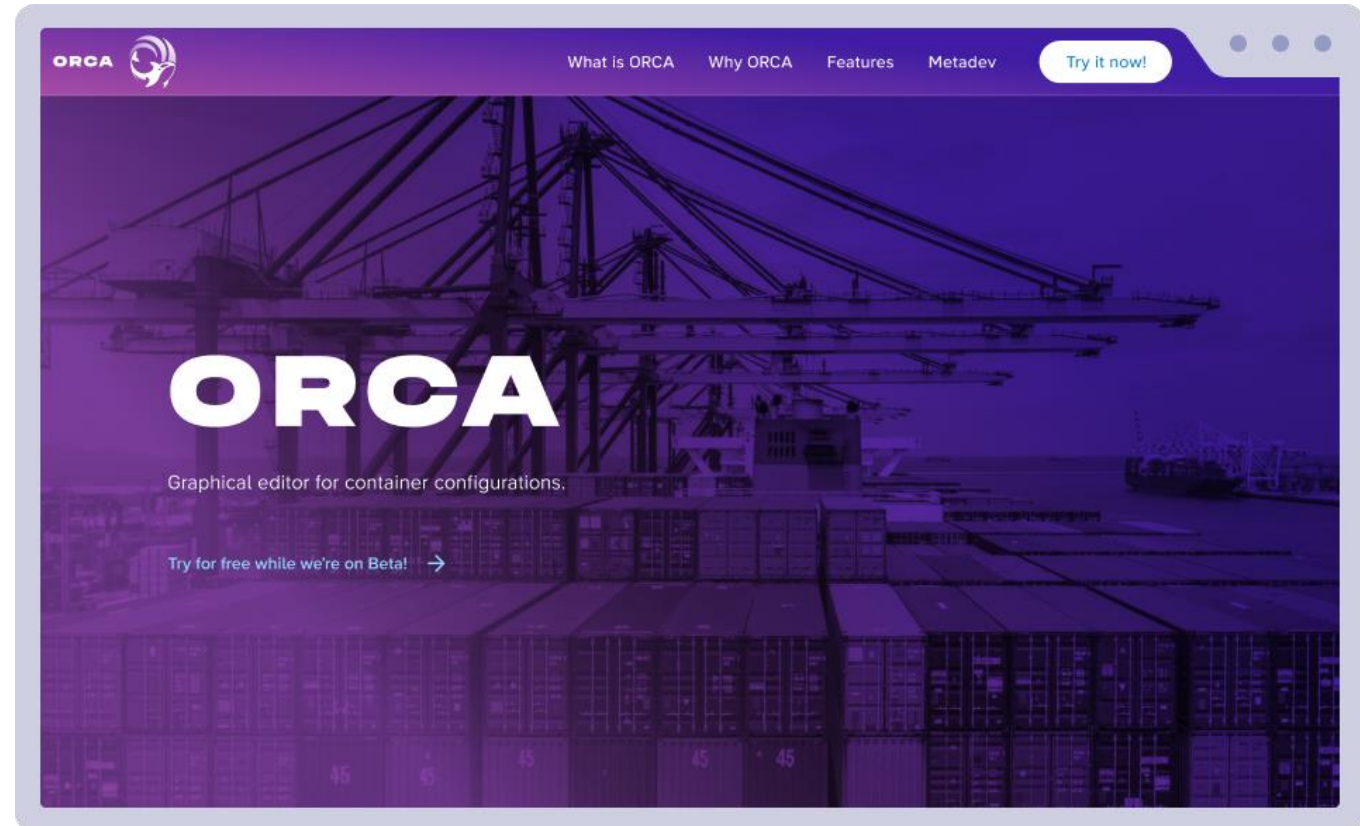
Use Cases

- Remote work
- Online Real-time collaboration
- Offline work with automatic reconciliation



Demo

<https://orca-tool.com>



Merging problems

- Ordering of actions in time
- Sync Time/Clocks on machines → Rely on logical clocks
- Ambiguities and contradicting actions



CRDTs to the rescue!

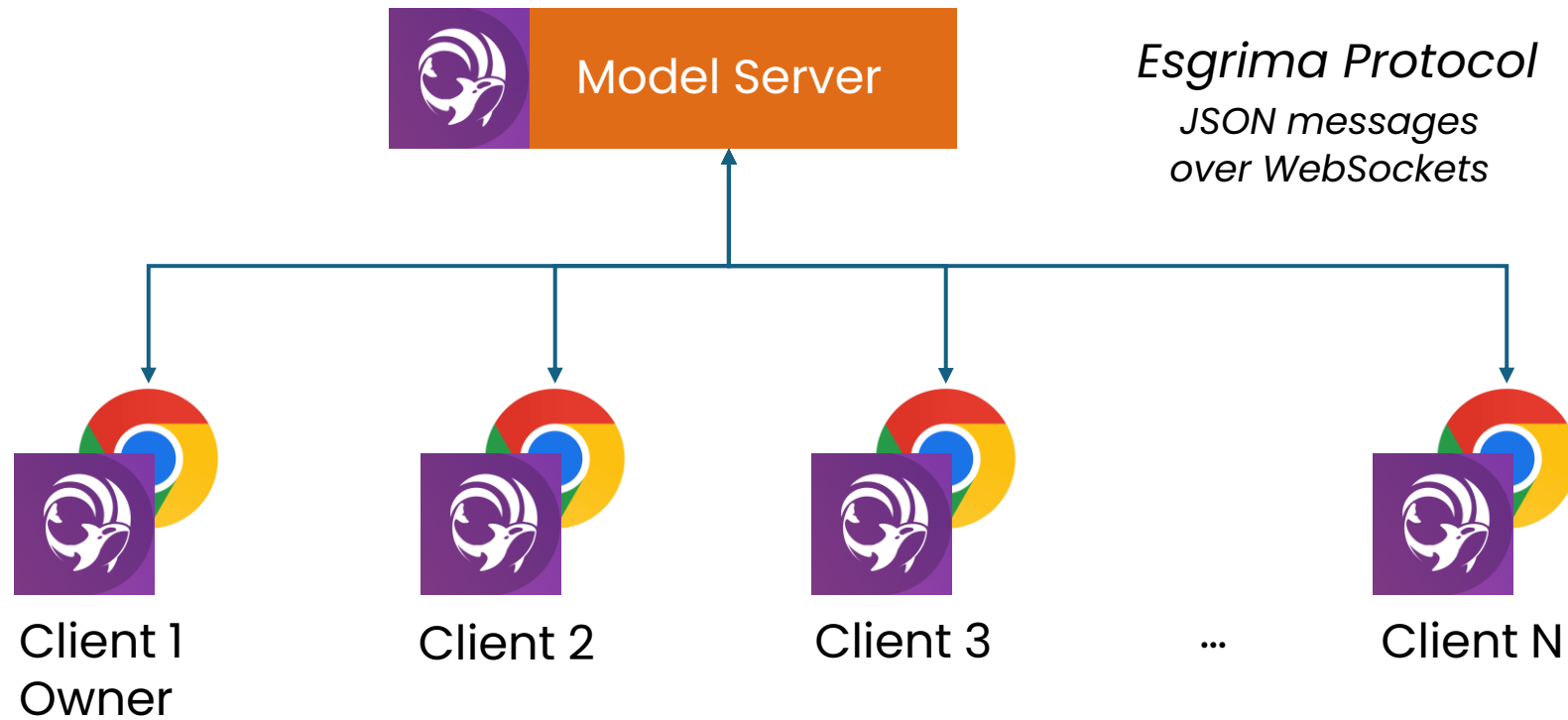
- **Conflict-free Replicated Data Types (or Collaborative Data Structures)**
 - List
 - String values
 - Literal values
- Sync Time/Clocks on machines → Rely on logical clocks
- Ambiguities →
Resolved by design choices based on semantics (first one wins for example)



CRDT example



Architecture



Key Architecture

Key Decisions:

- Metamodeling support for collaboration & CRDTs (opinionated)
- Implemented in Daga first
- Used by Orca later
- Central server (cloud or on premise)
- Comms via WebSockets + JSON (evaluating Protobuff)
- Security in place (authenticated users)
- UX: as simple as possible → **Share** metaphor



Usability



Invite people to this board so they can collaborate with you, even in real time.

Share Changelog

Share **ON**

Invite link

<https://orcatool.com/board/nnd08S>

COPY CHANGE LINK

Mike Vaughn ▶ Online

Pedro J. Molina ▶ Online

PS Paco Soria

Invite people to this board so they can collaborate with you, even in real time.

Share Changelog

- PS Changed a value in a connection 13s ago
- Changed a setting in **WebApp** 24s ago
- Changed a value in a connection 56s ago
- Changed a value in a connection 1m ago
- PS Connected **WebApp** with **Public** 2m ago
- Added **WebApp** block 2m ago
- PS Added **Public** block 5m ago

Design Implications

Added metadata:

- Every model item needs a unique ID (GUIDS)
- Logical time tracking (*o1 was created before o2*)
- Logic deletion of model items

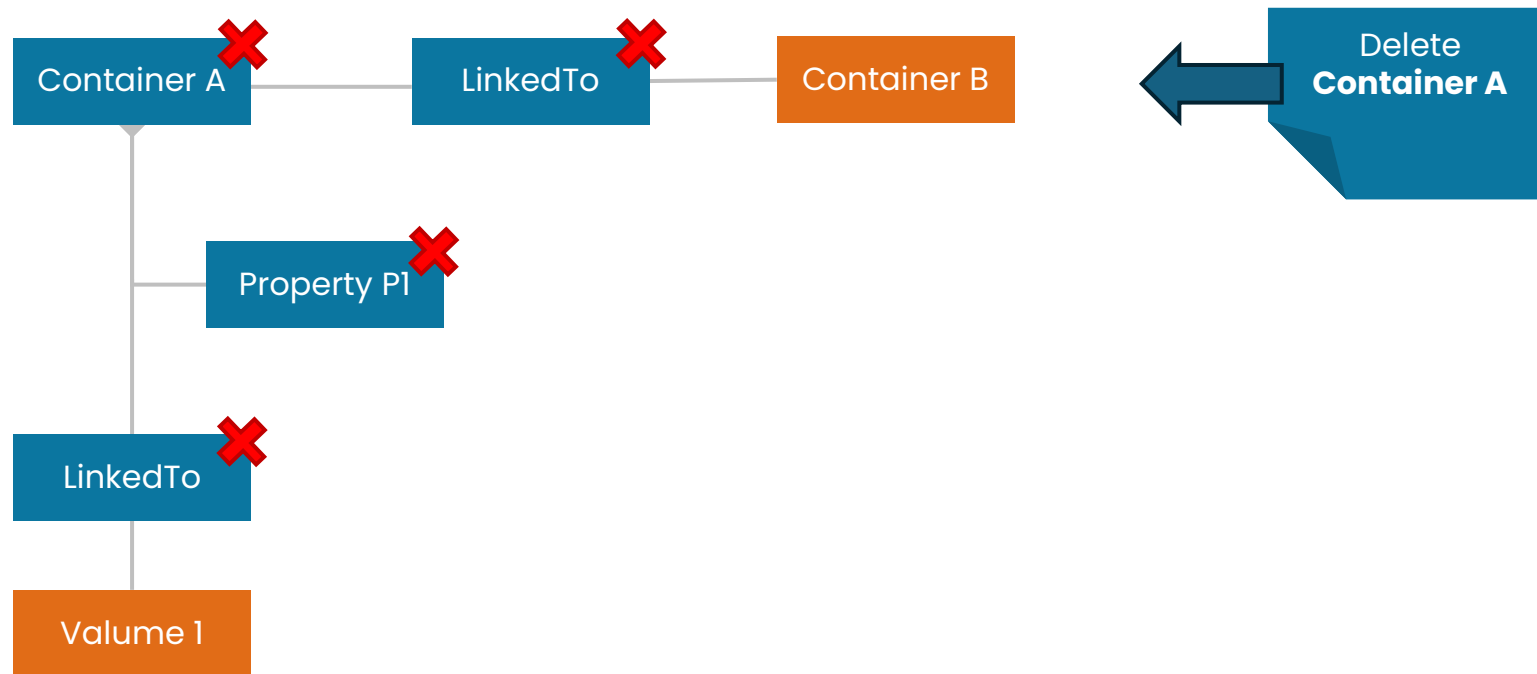
ID="advx2321"

removed=true

Cascade Deletions

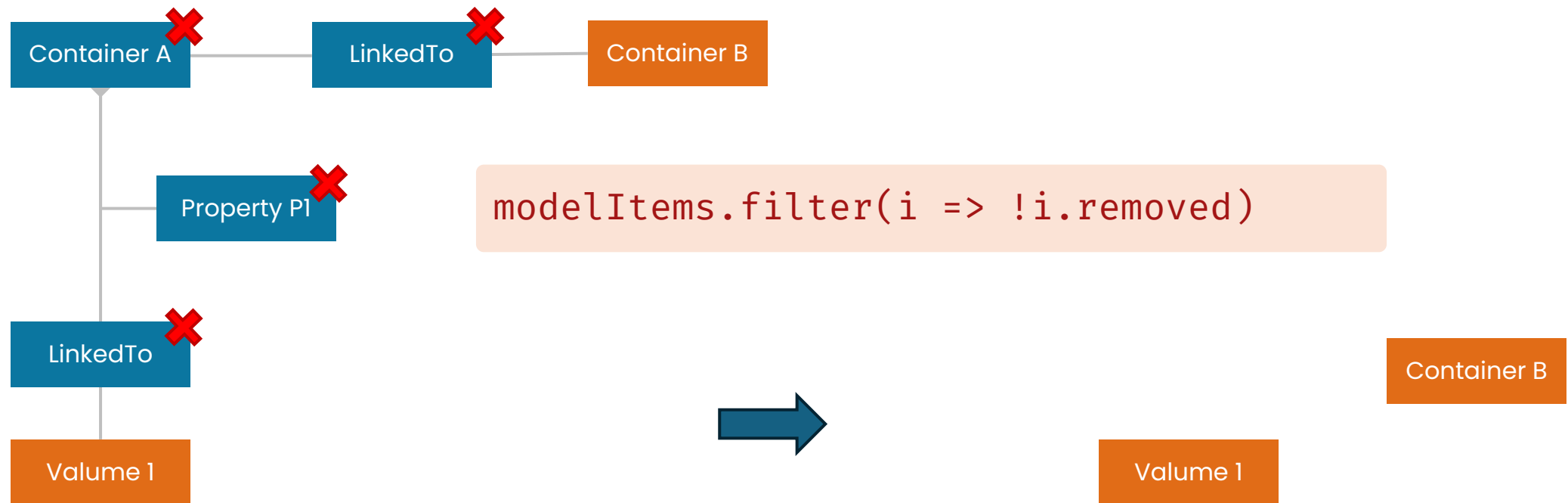
Handling **Cascade Deletions** on reconciliation

Based on the semantics of aggregation



Canonical Models

Canonical Models: projections as snapshots of the model with deletions filtered out at a certain point of time (a consolidated version).



Esgrima Protocol

- A formal spec to describe the communication between clients & model server
- Description of messages

HELO

BYE

CREA

CAK

ENRO

DLTE

ADD

ERR

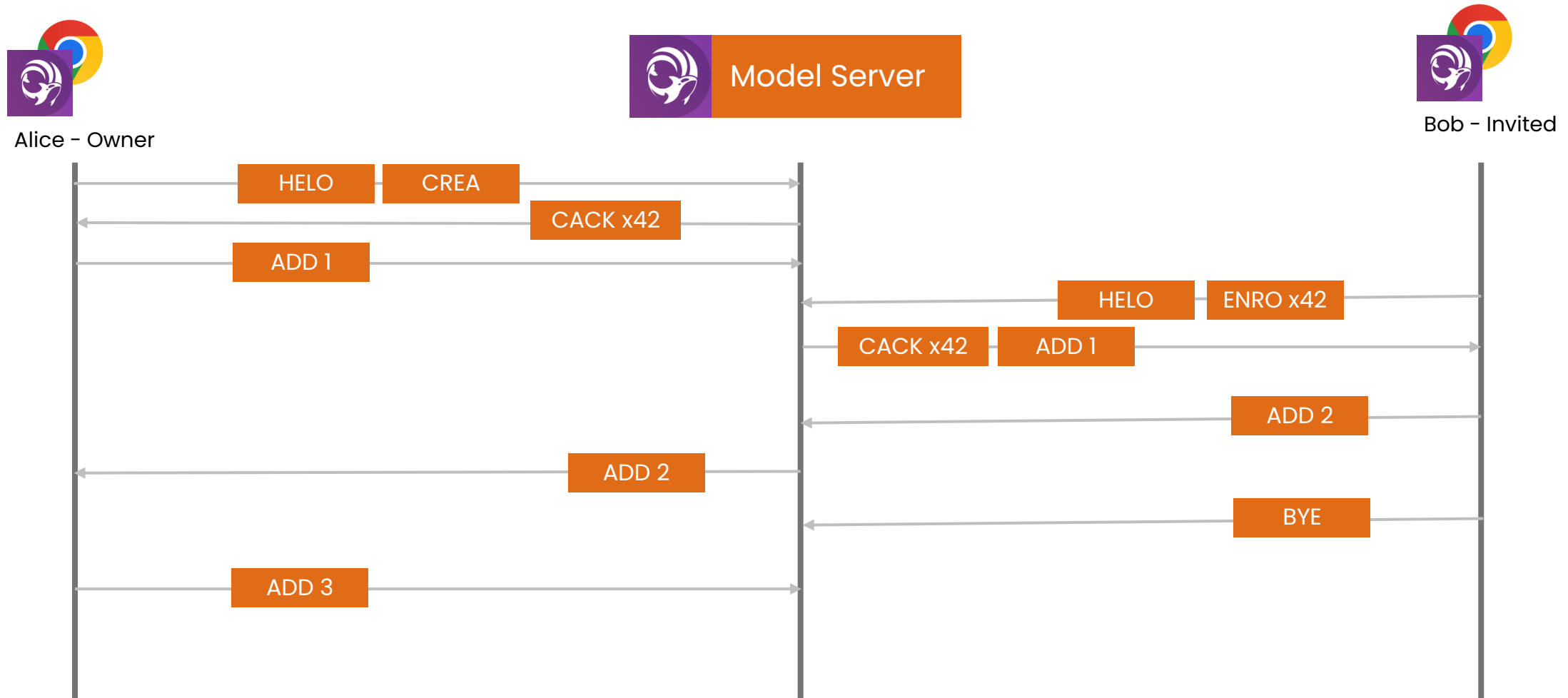
- Unique Identification of a share session, users & user sessions
- Logic deletion
- Broadcast of changes with deltas (using logic times)



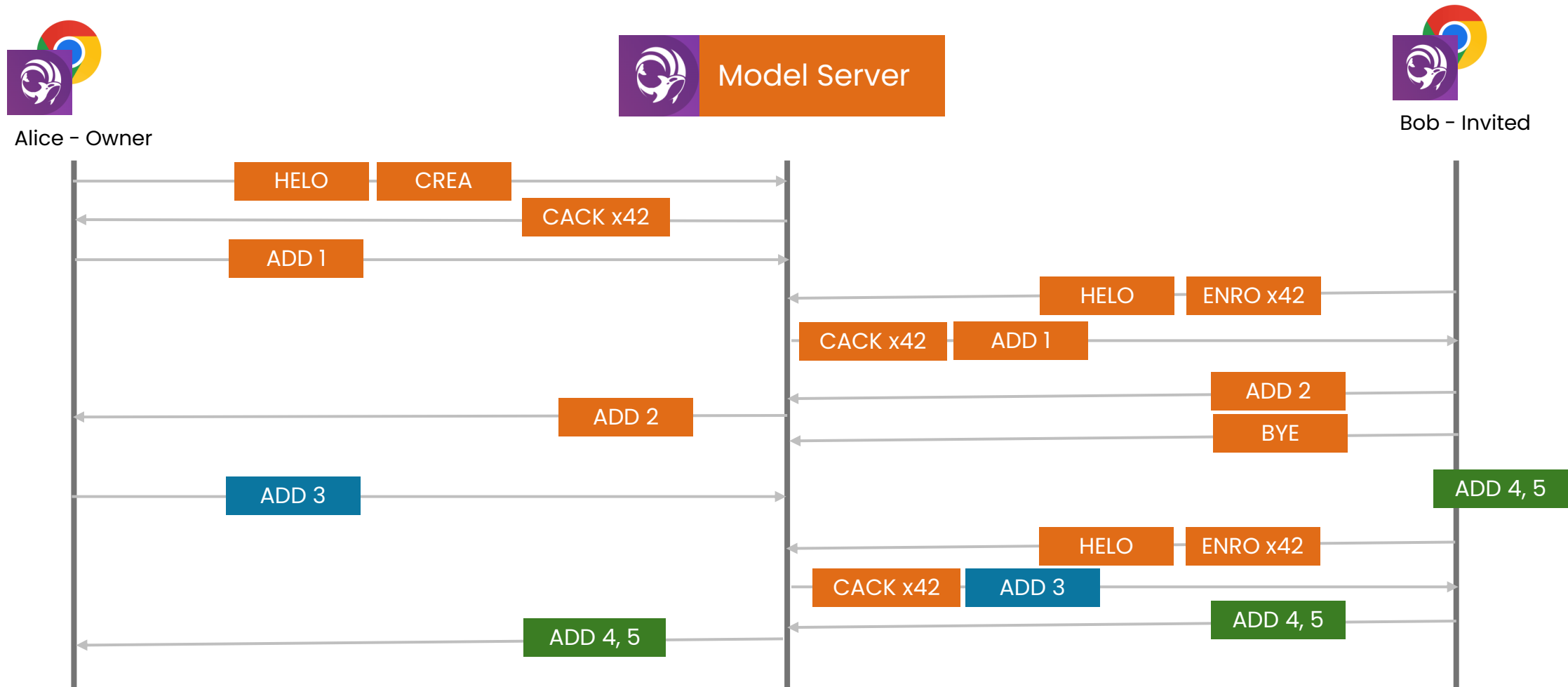
The screenshot shows a WebSocket client interface with a list of messages. The interface includes a search bar, a filter dropdown, and a table of messages. The table has columns for 'Data' and 'Length'.

Data	Length
↑ {"type":"HELO","clientId":"DEEBA9CDB744A092BD4CD678","userId":"64c7f4c1d25c63c74da6a374","version":"1.0","ts":"2024-08-29T11:02:18.589Z","token":"eyJhbGciOiJIUzI1NiIsInR5cCI6IkpXLTUzIiwiaWF0Ijoi2024-08-29T11:02:18.589Z"}...	1011
↓ {"type":"OK","clientId":"DEEBA9CDB744A092BD4CD678","userId":"64c7f4c1d25c63c74da6a374","responseTo":"evrYqH5zYWU8UOA6M6CCs0HpCtHBTlhud8Zi2mSgzmw=","ownerId":"","ts":...}	222
↑ {"type":"CREA","clientId":"DEEBA9CDB744A092BD4CD678","userId":"64c7f4c1d25c63c74da6a374","version":"1.0","ts":"2024-08-29T11:02:18.616Z","token":"eyJhbGciOiJIUzI1NiIsInR5cCI6IkpXLTUzIiwiaWF0Ijoi2024-08-29T11:02:18.616Z"}...	1417
↓ {"type":"CAK","clientId":"DEEBA9CDB744A092BD4CD678","userId":"64c7f4c1d25c63c74da6a374","responseTo":"0QVLe635n53yx6WiGG4z6zg5kL2yu8YUHwl4BPuIH6s=","locator":"HXFNA...}	245

A. Connected Scenario



B. Disconnected Scenario



Conclusions

- We have explored CRDTs to allow online & offline model changes
- Incorporated in the Daga & Essential lib. as a **foundation capability**
- Orca: First practical demonstration
- Ready to incorporate in other products as an out-of-the-box feature

- Next steps:
 - Usage in other domains with Daga & Essential
 - Test it with bigger models
 - Test with more clients connected
 - Test large sessions sharing sessions (months)
 - Improved security from well know URL to Access Control List



References

1. CRDTs Survey, Matthew Weidner

<https://mattweidner.com/2023/09/26/crdt-survey-1.html>



Thanks!

Try it free at <https://orca-tool.com>



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Seville 17-19 October, 2024

<https://langdevcon.org>