Loosely Coupled Approach for Web-Based Collaborative 3D Design

Doctoral Symposium - DEBS 2017

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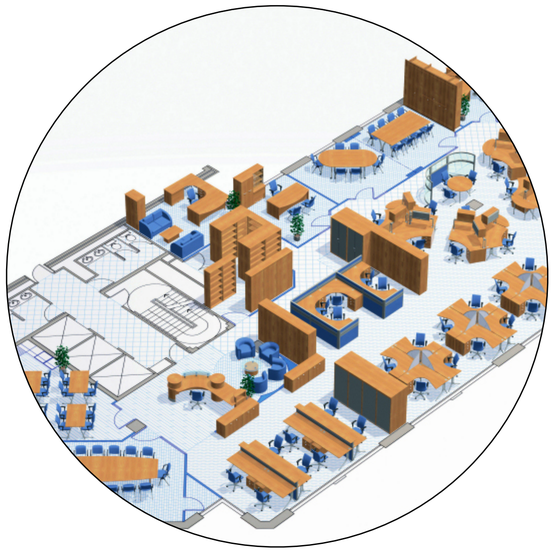
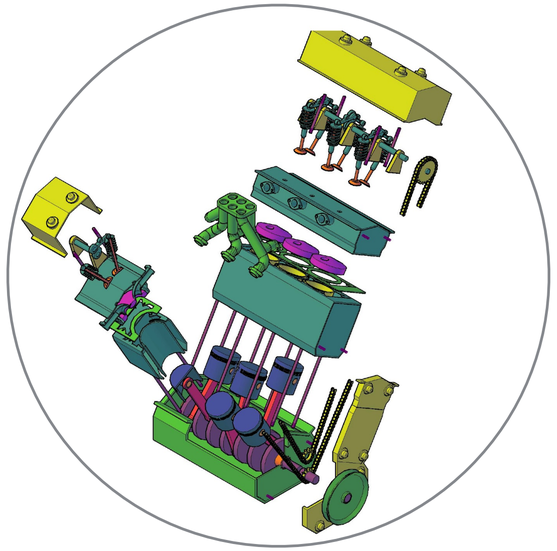
Context

Web-based collaboration



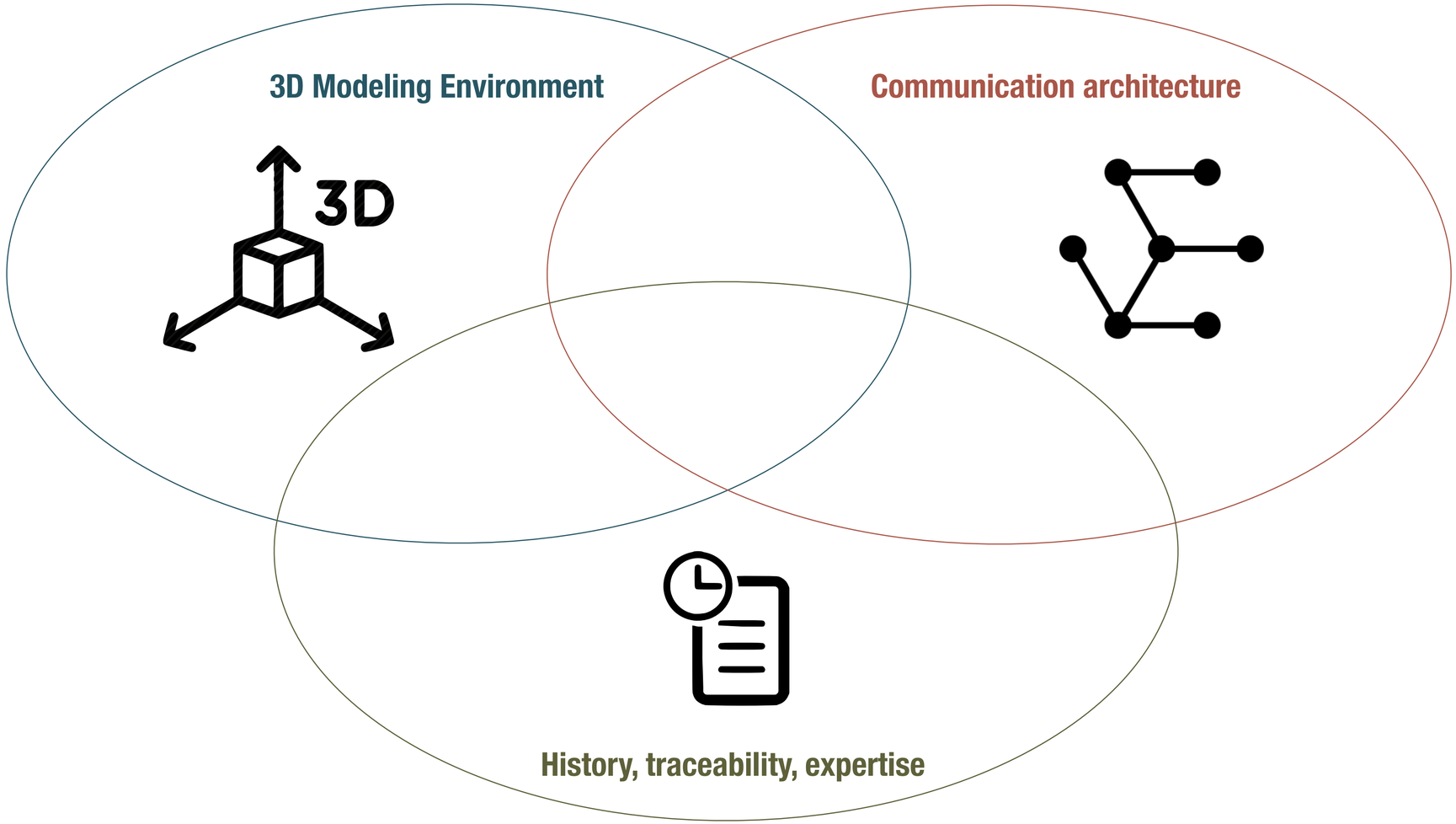
Space planning



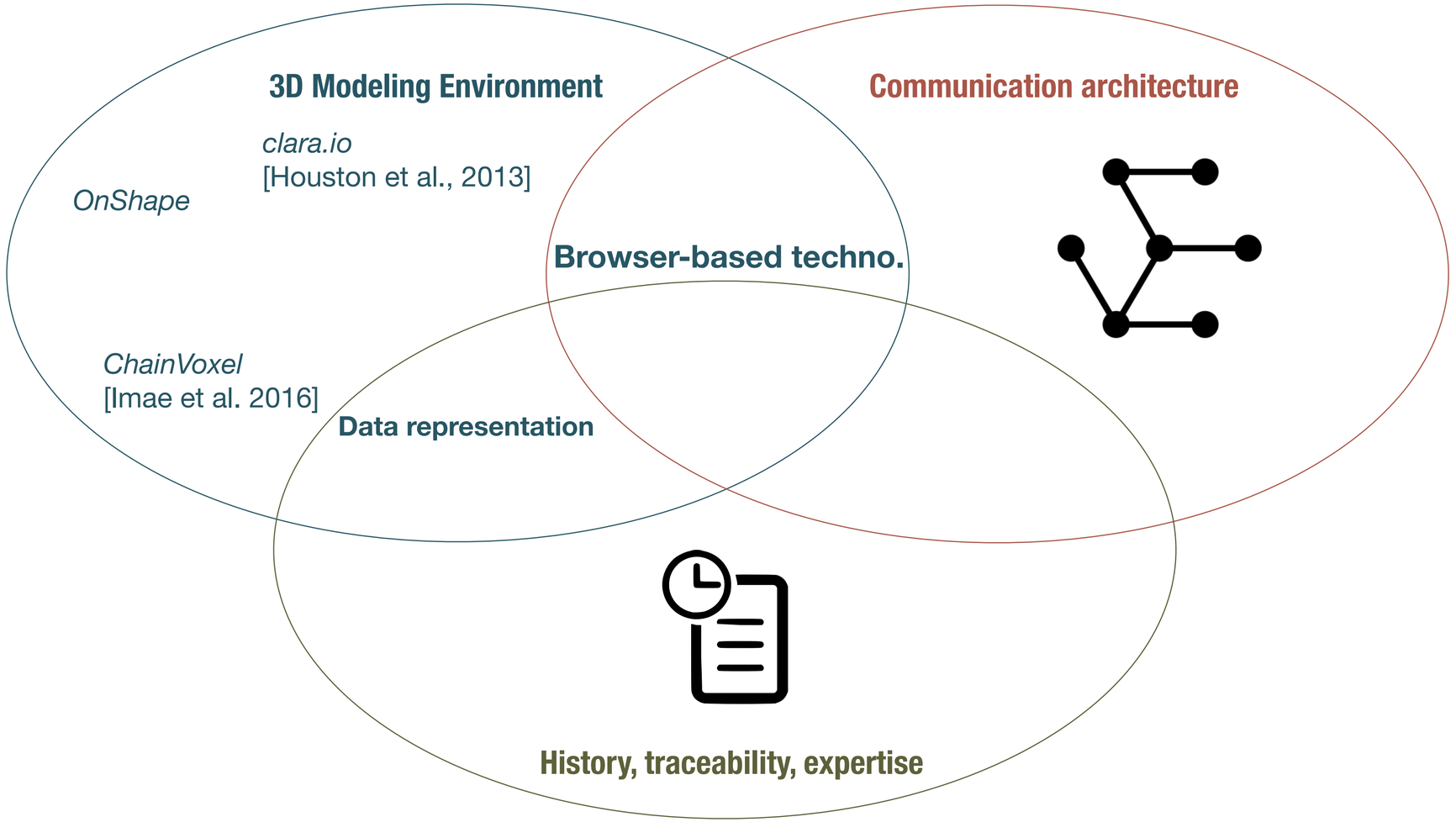
CAD

How to leverage client resources to enhance the collaboration?

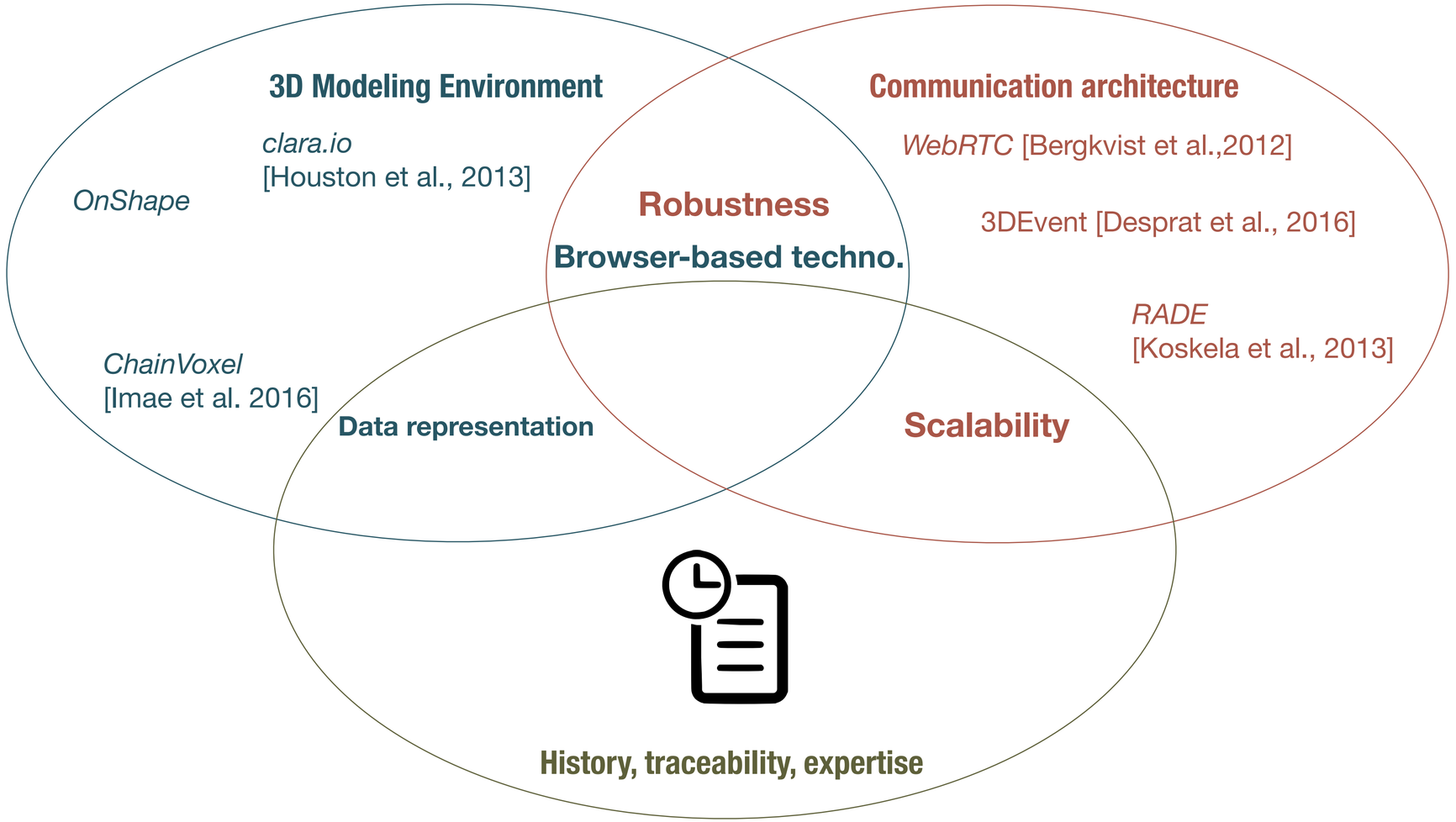
Related works



Related works



Related works



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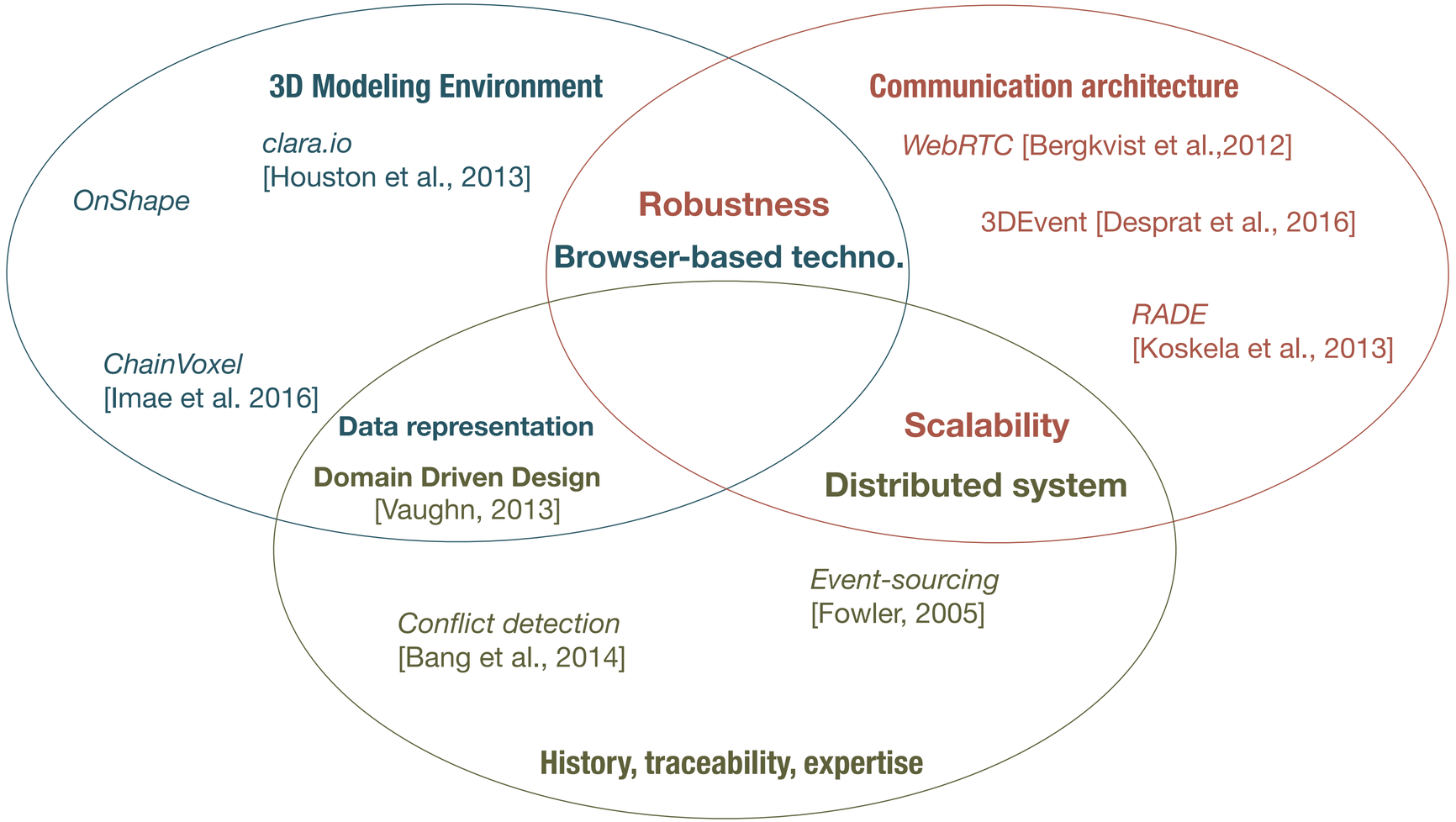

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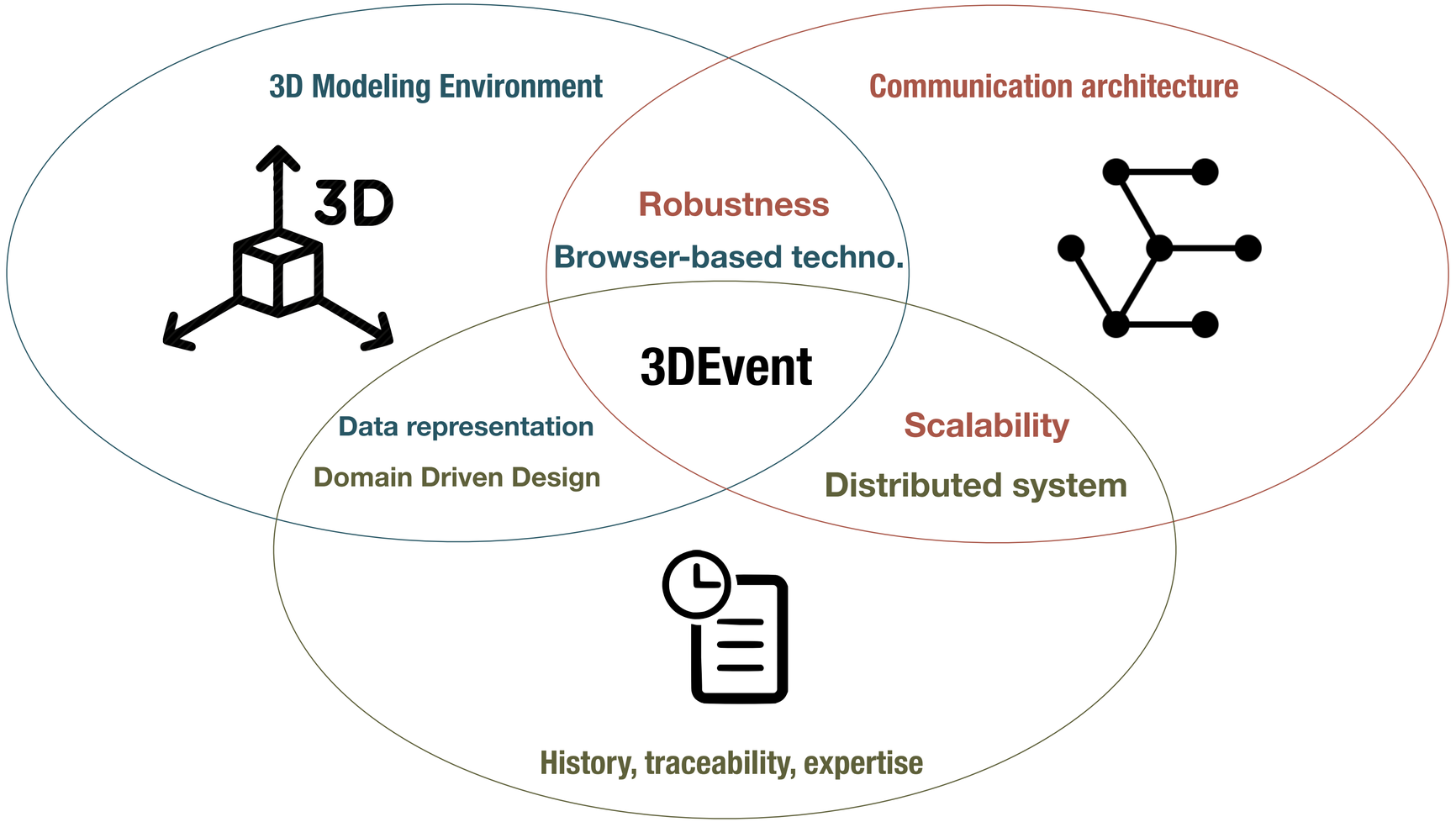
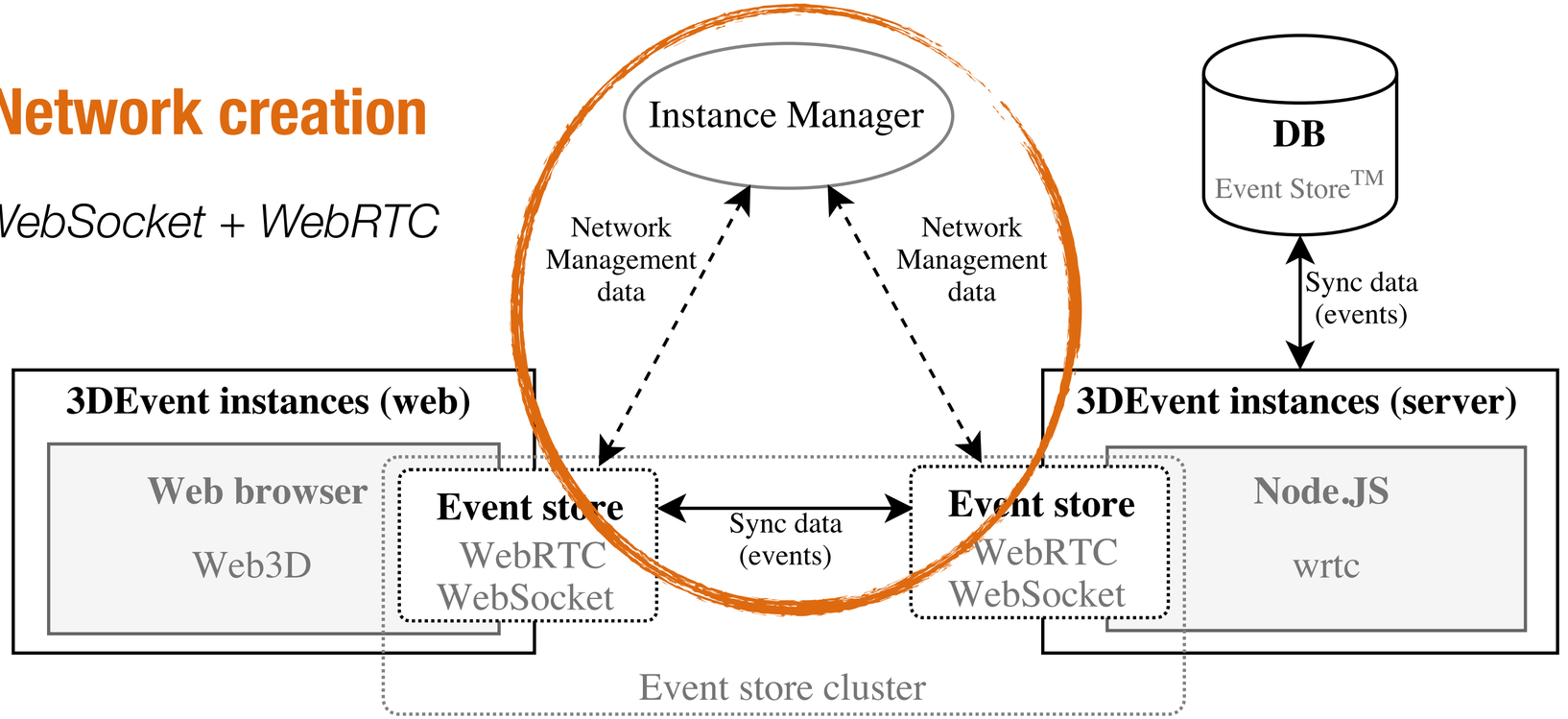


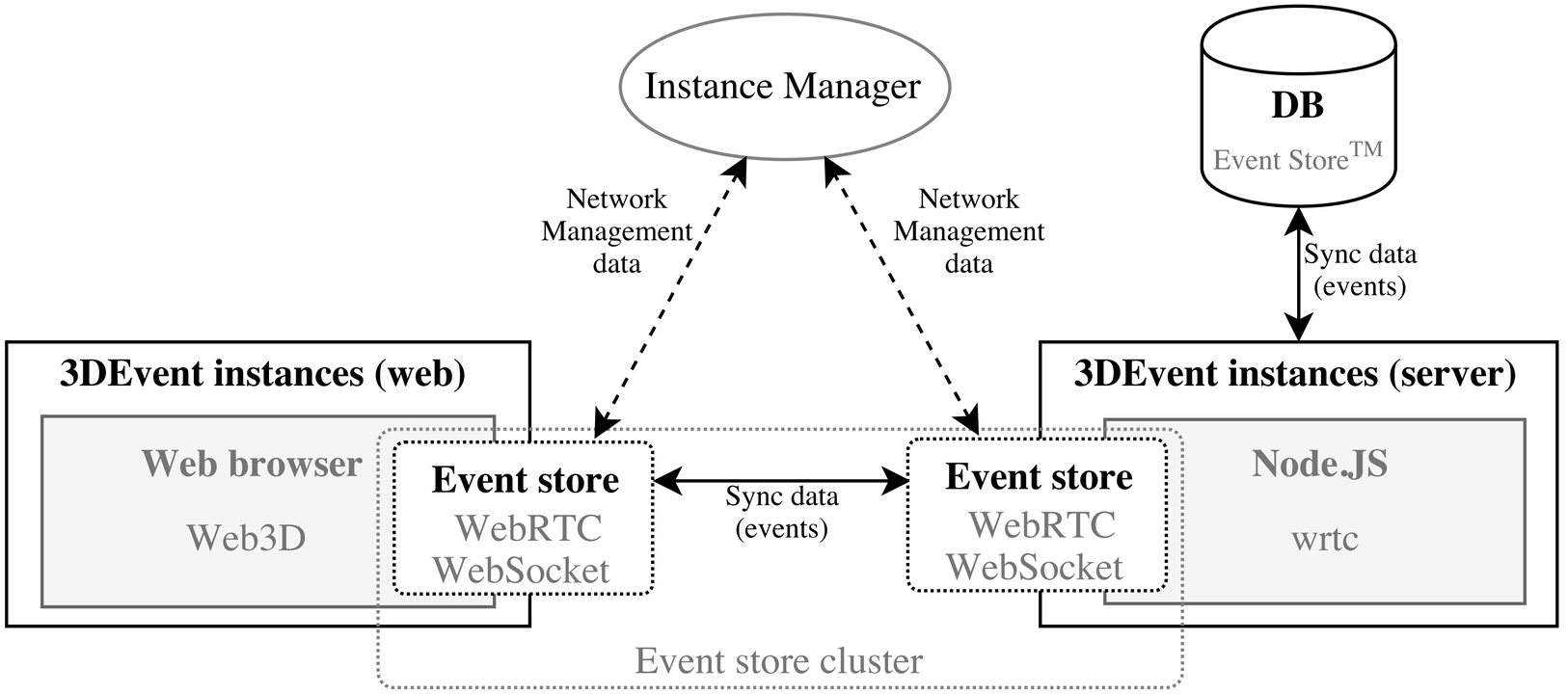
Communication Architecture

Network creation

WebSocket + WebRTC

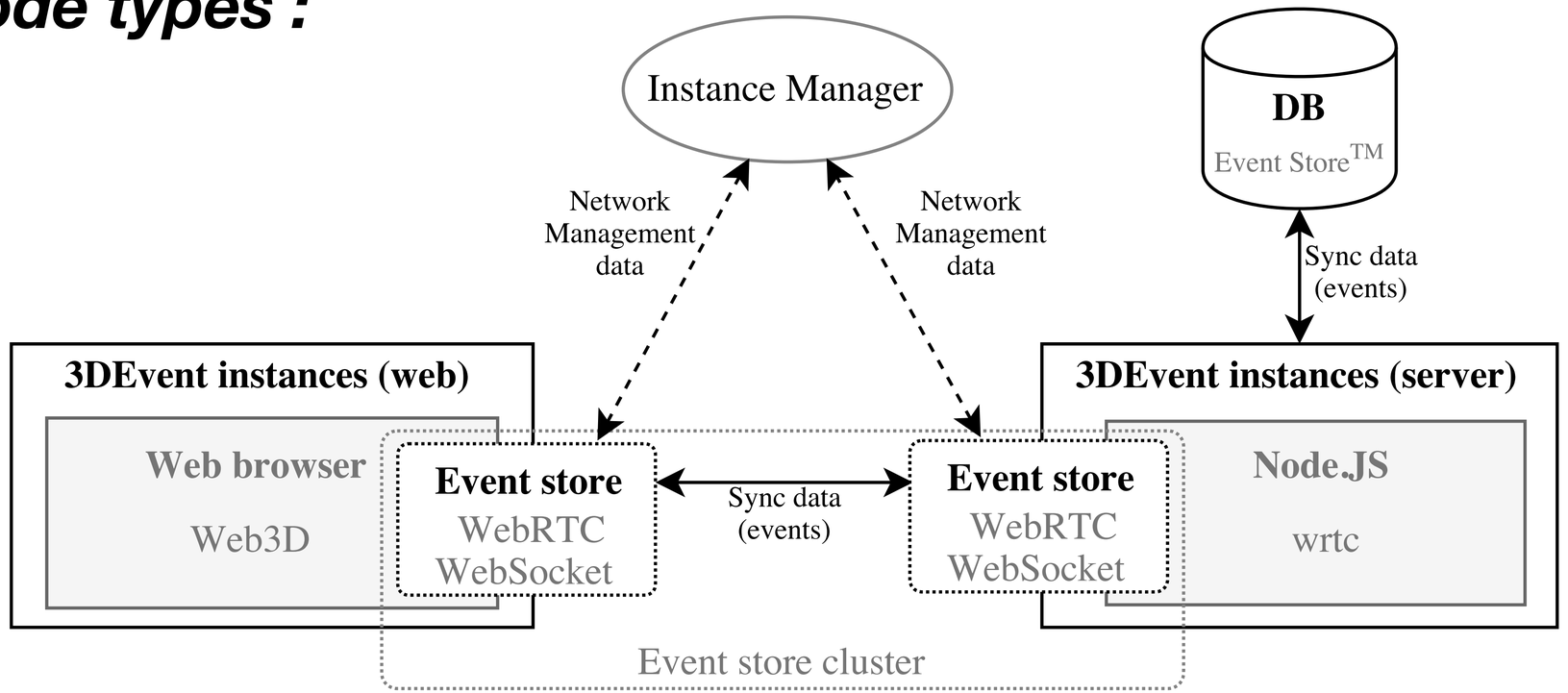


Event sourced components



Event sourced components

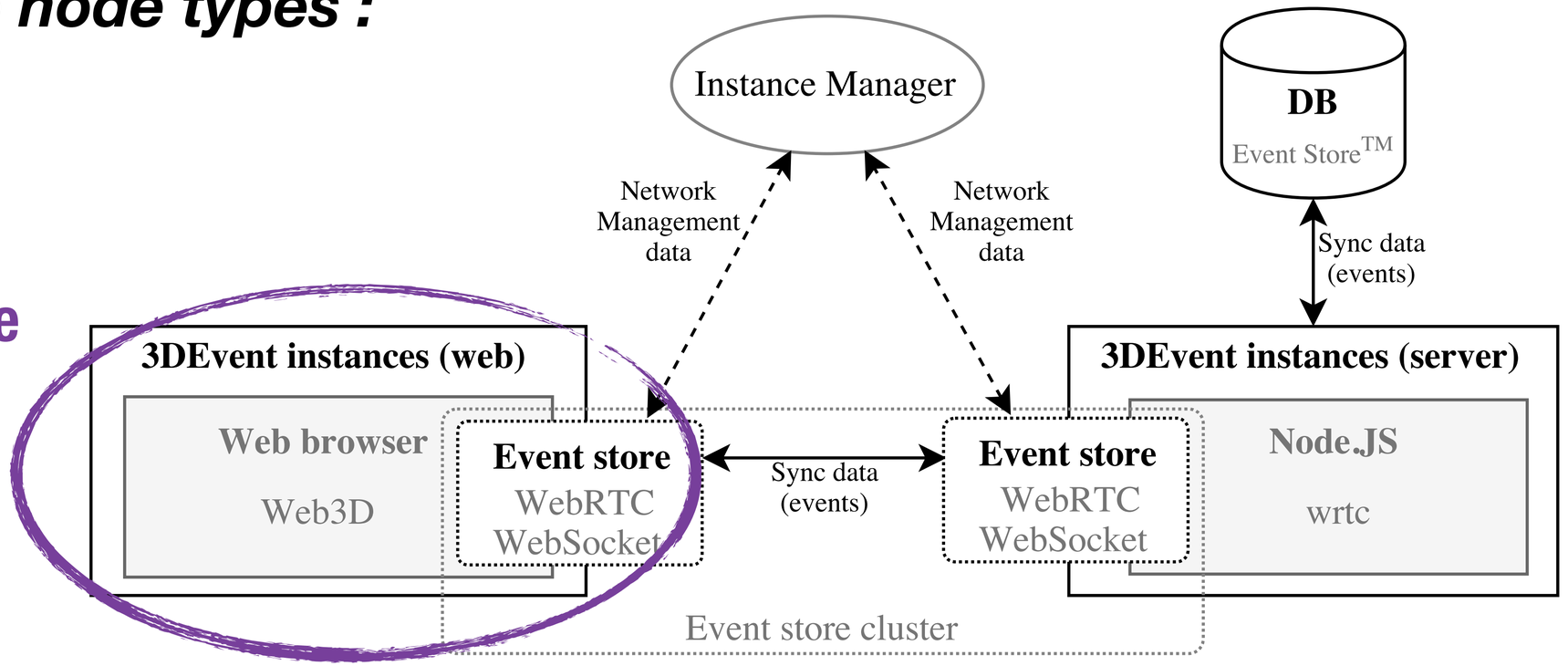
Two node types :



Event sourced components

Two node types :

Active Node

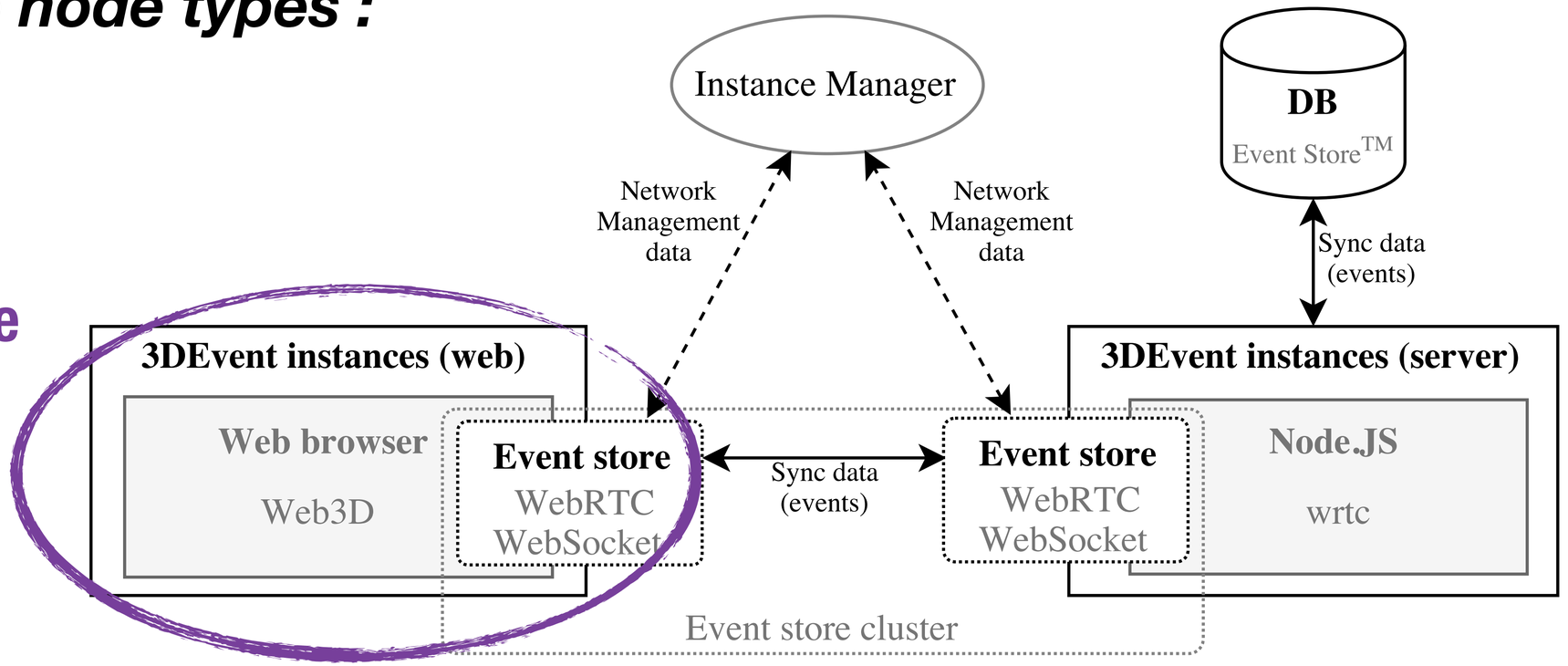


Event sourced components

Two node types :

Active Node

Produce
Consume
Process
Write



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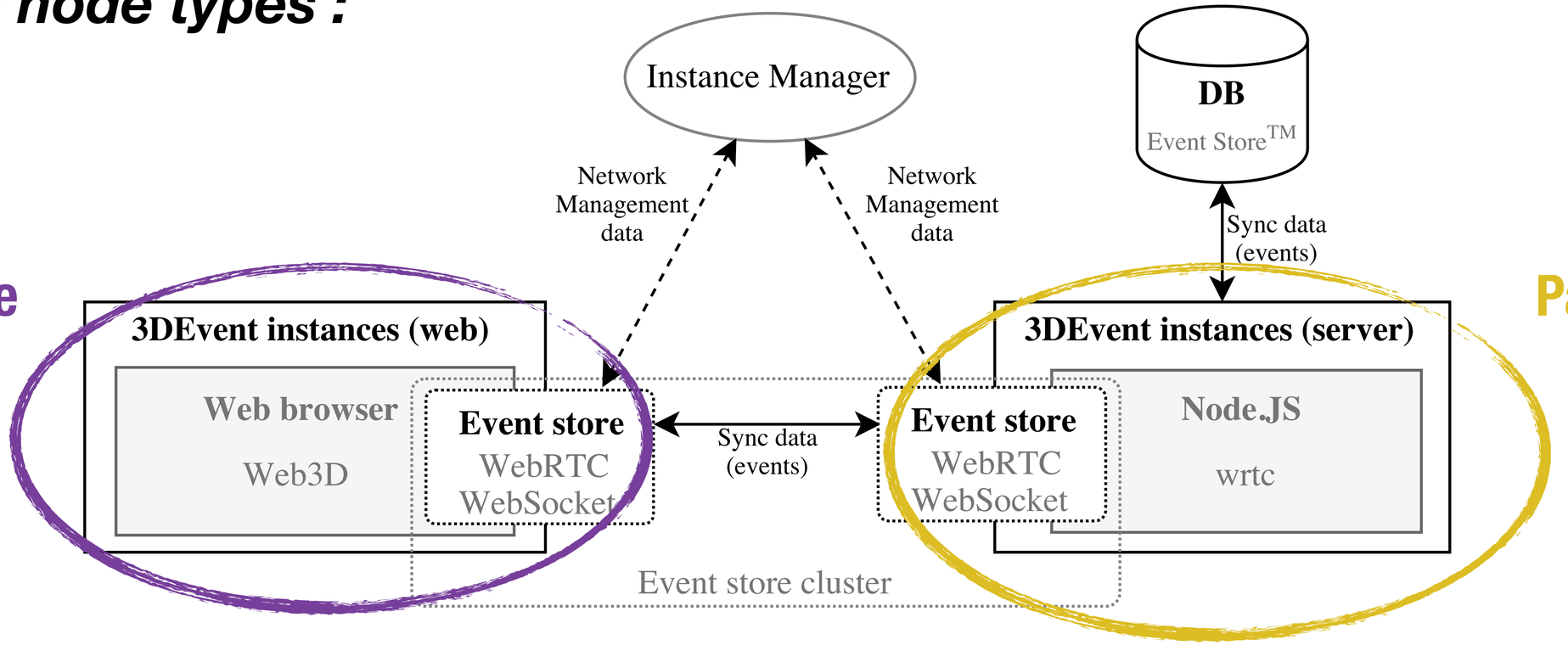
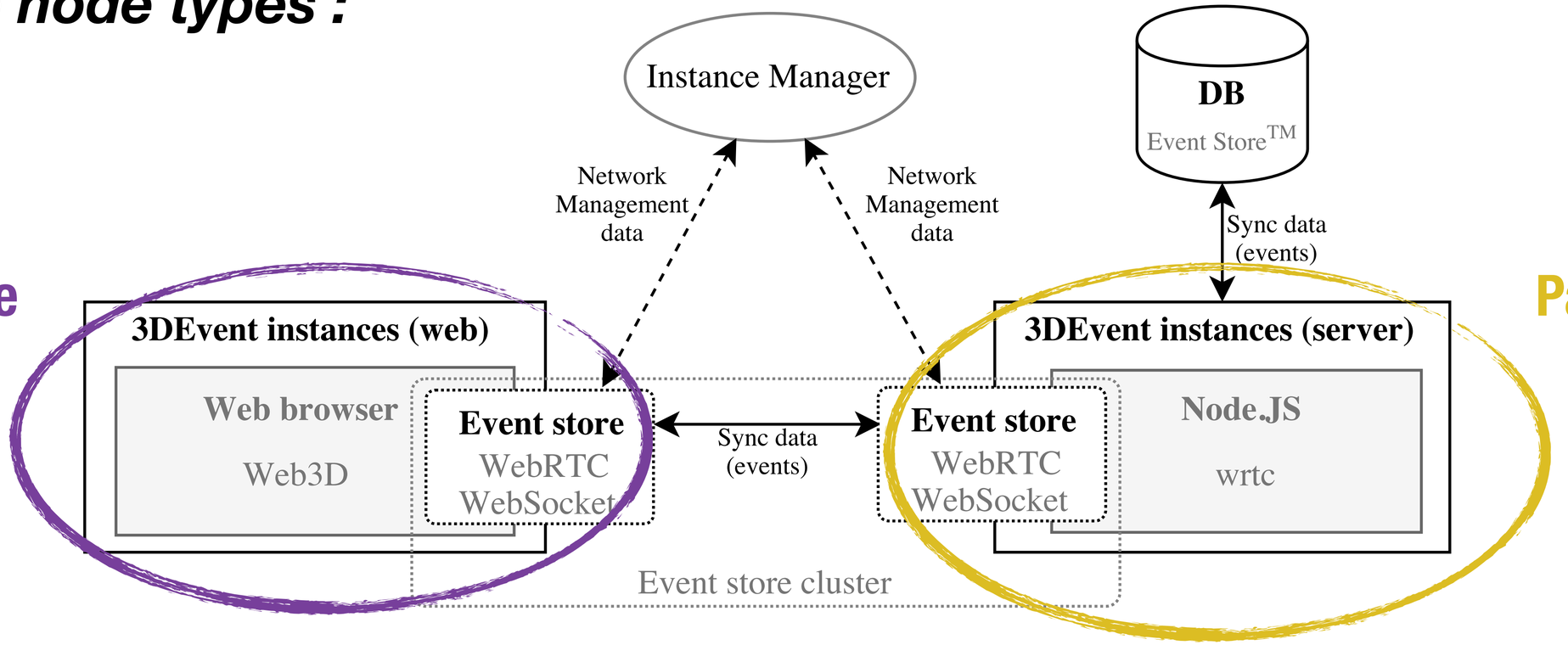


Passive Node

Event sourced components

Two node types :



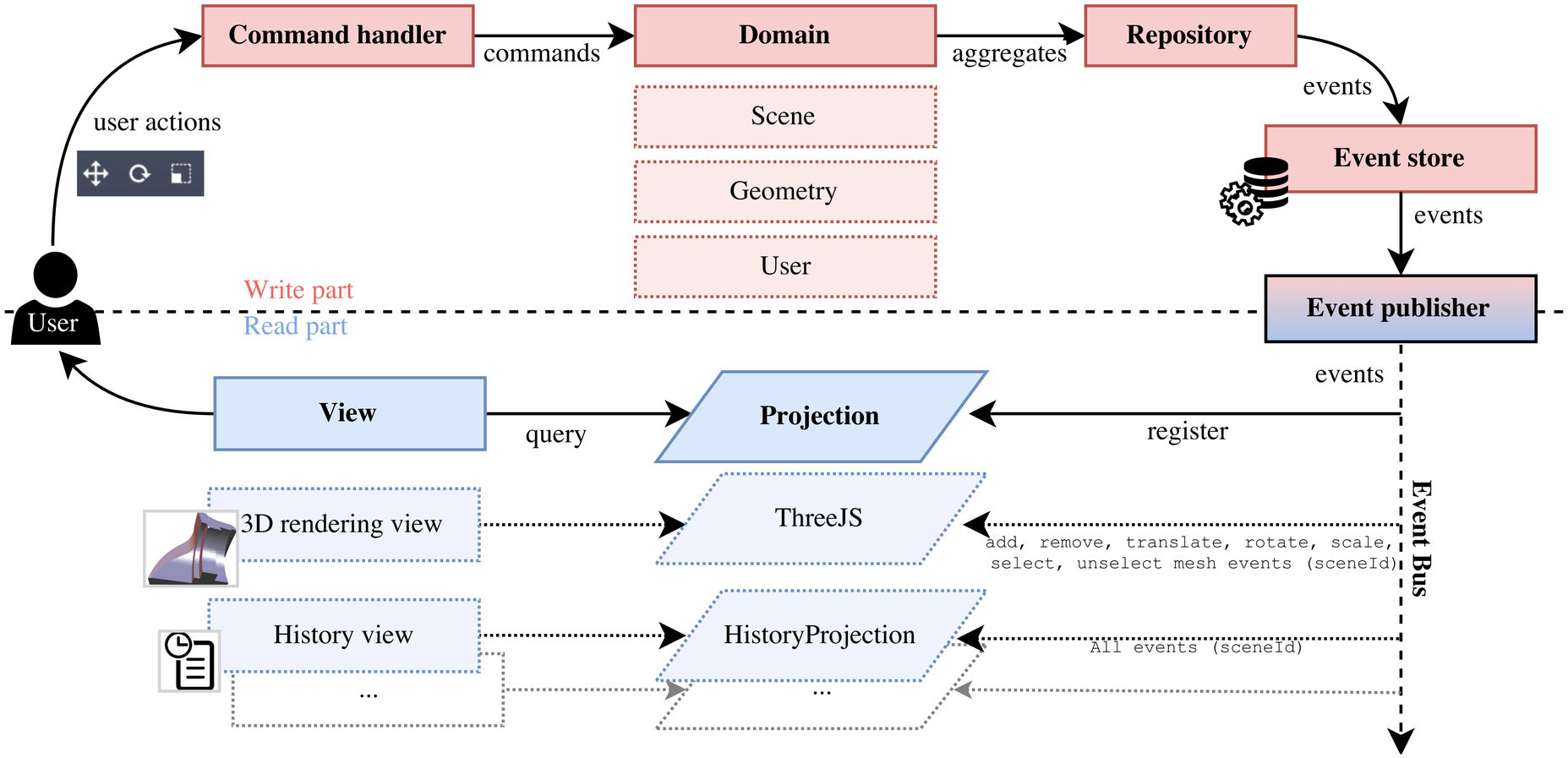
Active Node

Produce
Consume
Process
Write

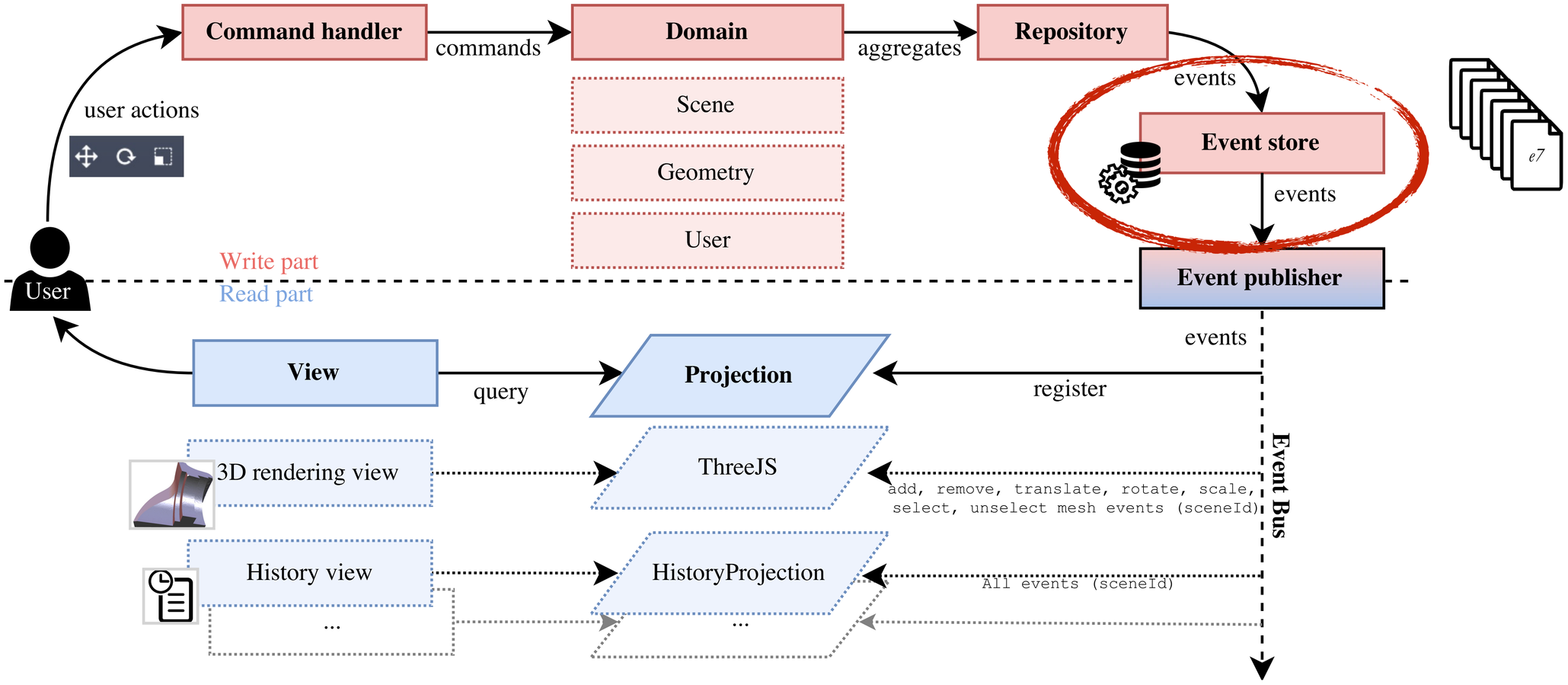
Passive Node

Produce
Consume
Process
Write

Active Node and CQRS (Command Query Responsability Segregation)



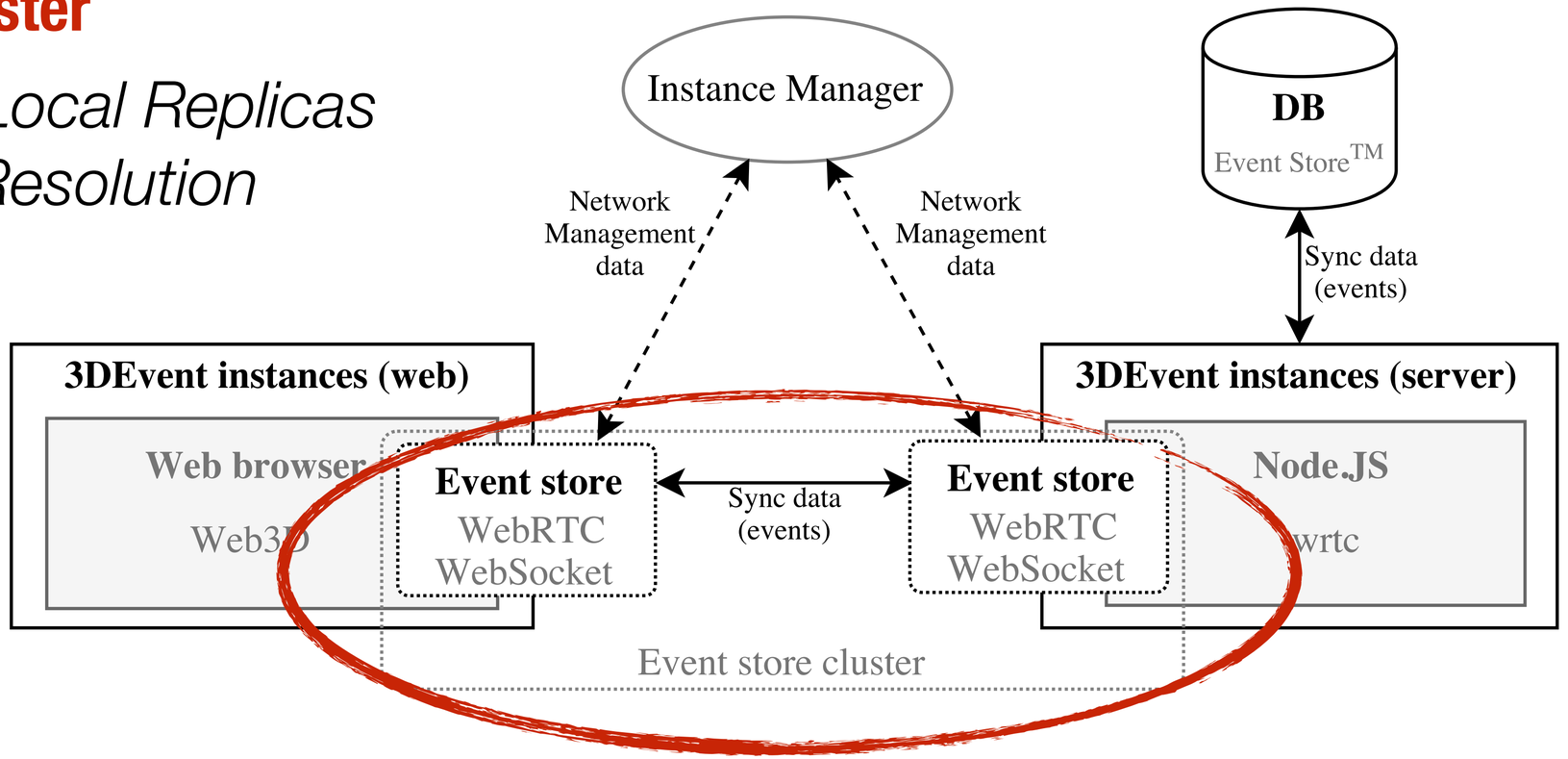
Active Node and CQRS (Command Query Responsability Segregation)



Event distribution

Cluster

Synchronize Local Replicas
Conflict Resolution

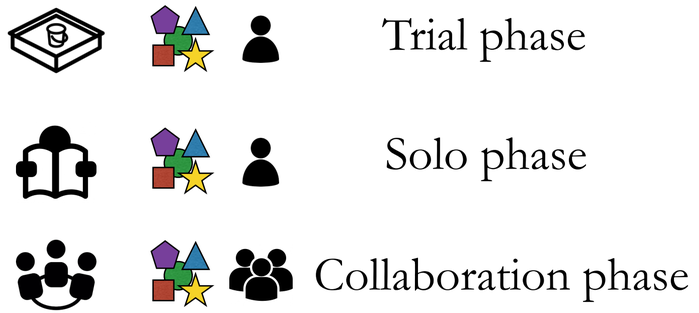


How does the distribution works?

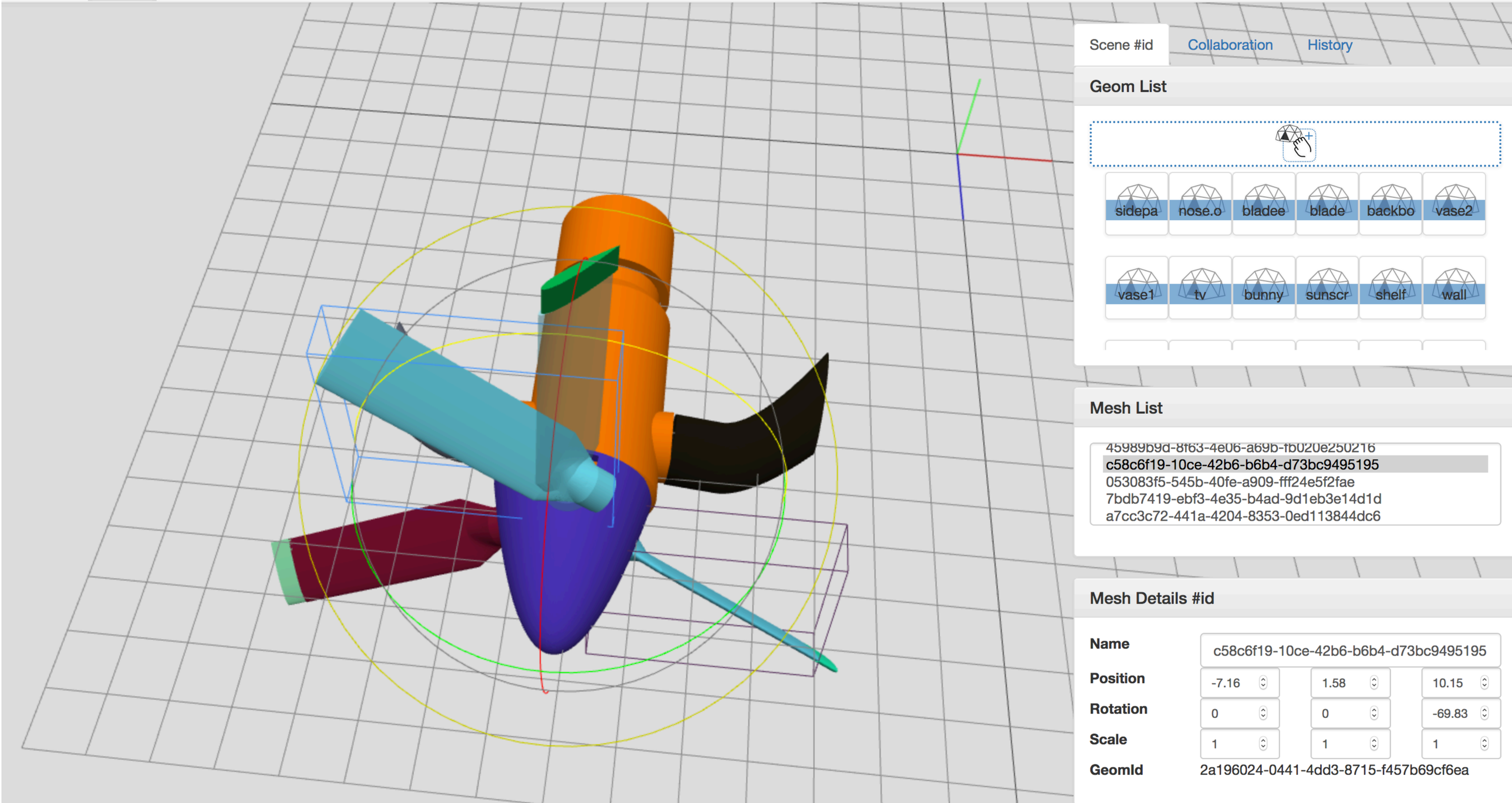
- Push-based updates
- Check of the version number (current vs expected)
- Replicate locally
- PS: Event Log in the database is the authoritative source of data.

Experimental setup

- 6 groups of 2 or 3 participants
- Real network conditions
- Cooperative task assembly
- 3 phases



Init phase 



Scene #id | Collaboration | History

Geom List

sidepa | nose.o | bladee | blade | backbo | vase2

vase1 | tv | bunny | sunscr | shelf | wall

Mesh List

45989b9d-8f63-4e06-a69b-fb020e250216
c58c6f19-10ce-42b6-b6b4-d73bc9495195
053083f5-545b-40fe-a909-fff24e5f2fae
7bdb7419-ebf3-4e35-b4ad-9d1eb3e14d1d
a7cc3c72-441a-4204-8353-0ed113844dc6

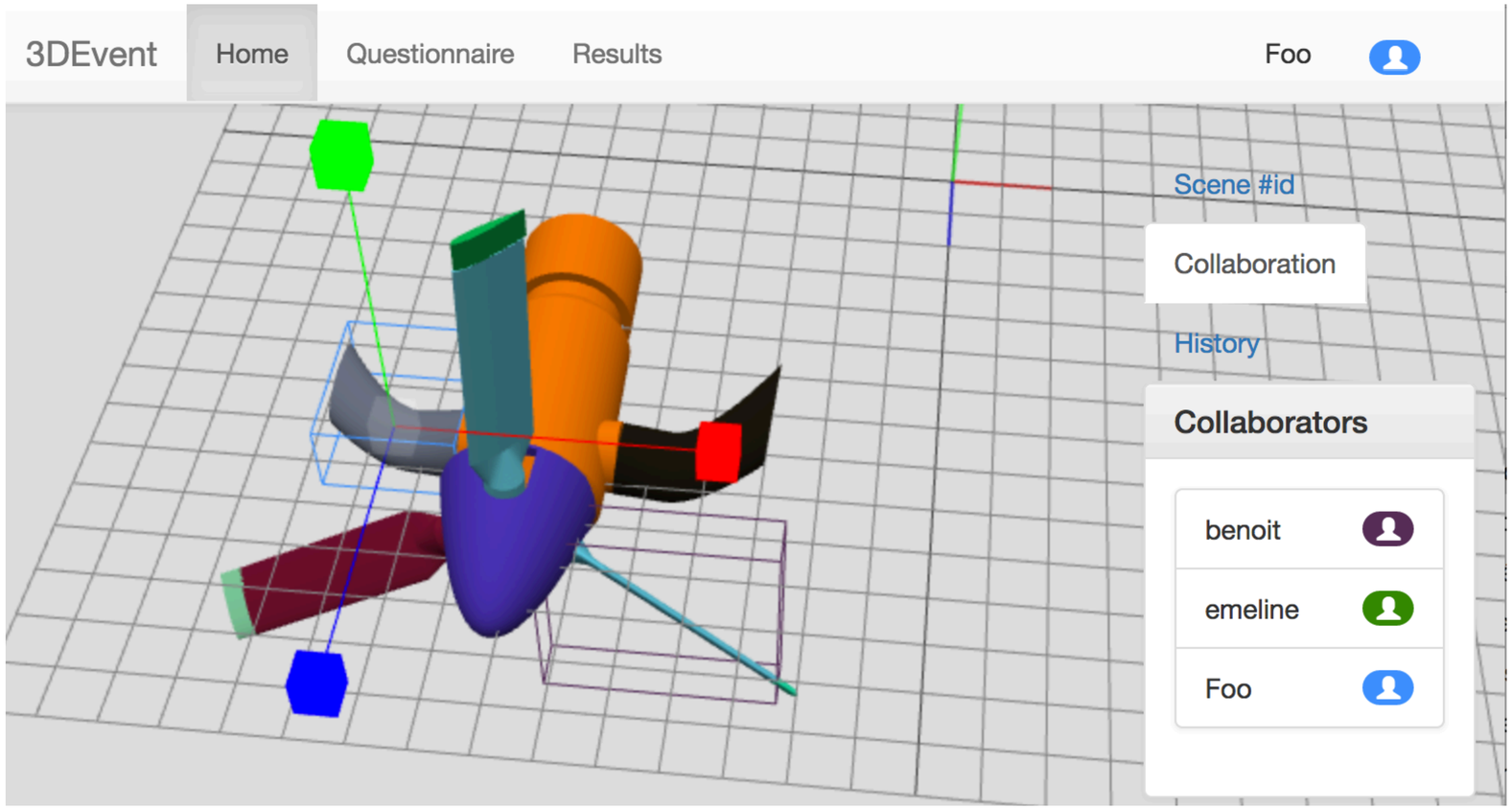
Mesh Details #id

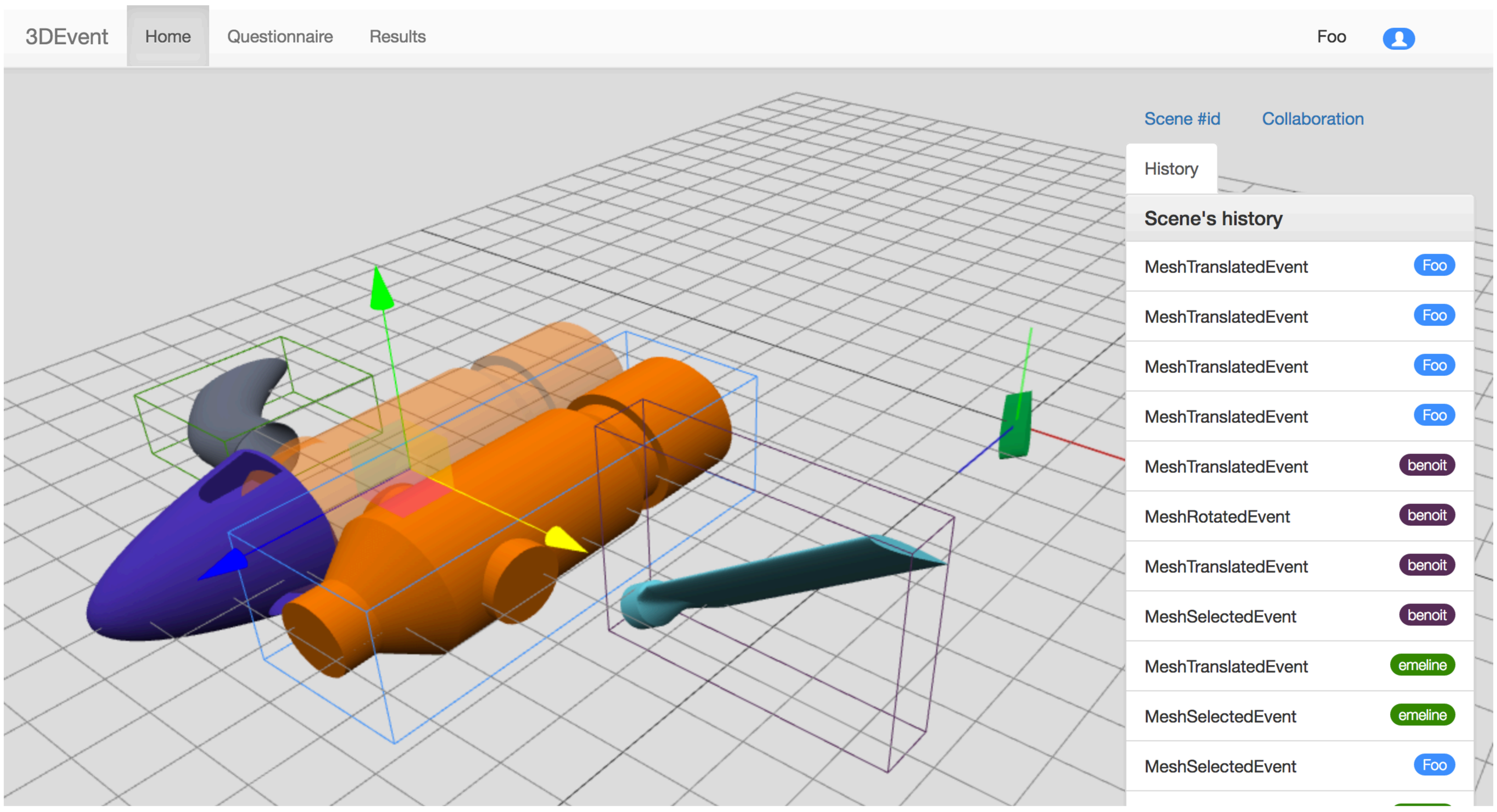
Name	c58c6f19-10ce-42b6-b6b4-d73bc9495195		
Position	-7.16	1.58	10.15
Rotation	0	0	-69.83
Scale	1	1	1
GeomId	2a196024-0441-4dd3-8715-f457b69cf6ea		

Task based interface

Multiple views
of the same events

Embodiement of the user




3DEvent
Home
Questionnaire
Results
Foo
Scene #id
Collaboration
History
Scene's history
MeshTranslatedEvent Foo
MeshTranslatedEvent Foo
MeshTranslatedEvent Foo
MeshTranslatedEvent Foo
MeshTranslatedEvent benoit
MeshRotatedEvent benoit
MeshTranslatedEvent benoit
MeshSelectedEvent benoit
MeshTranslatedEvent emeline
MeshSelectedEvent emeline
MeshSelectedEvent Foo

Data collection

- Events from start to end
- Subjective Questionnaires

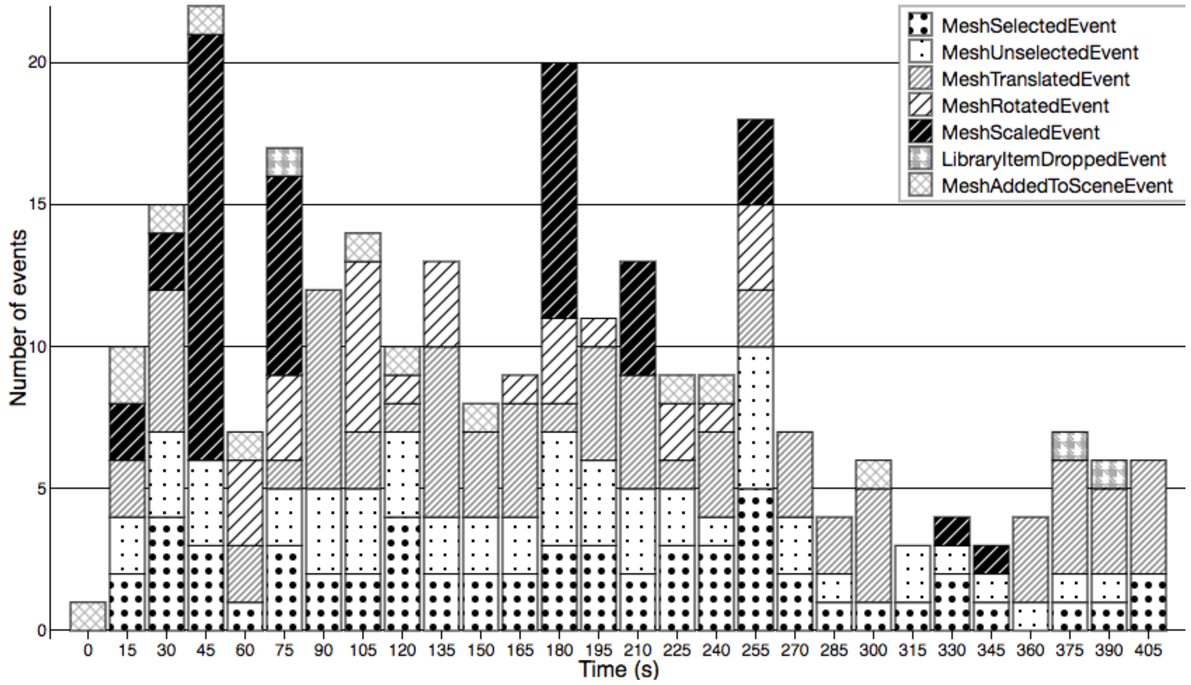
Event Stream 'scene-turbine'

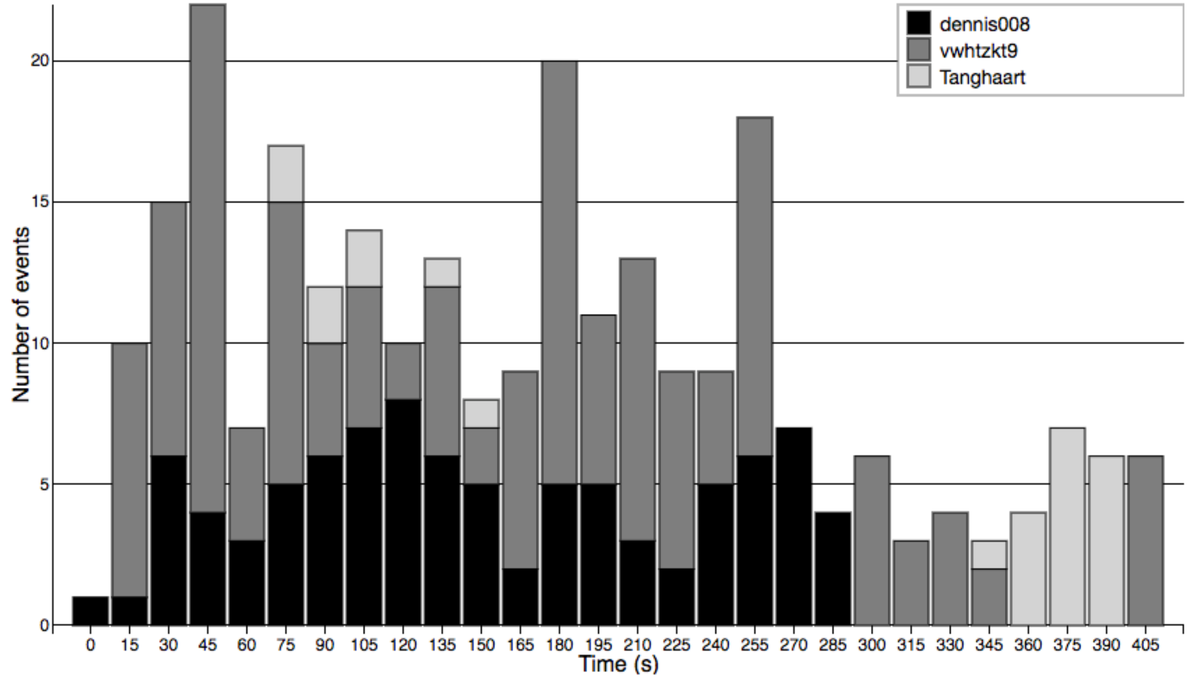
self | first | previous | metadata

Event #	Name	Type	Created Date
19	19@scene-turbine	MeshRotatedEvent	2017-03-12 18:18:52
18	18@scene-turbine	MeshTranslatedEvent	2017-03-12 18:18:52
17	17@scene-turbine	MeshAddedToSceneEvent	2017-03-12 18:18:52
16	16@scene-turbine	MeshScaledEvent	2017-03-12 18:18:52
15	15@scene-turbine	MeshRotatedEvent	2017-03-12 18:18:52
14	14@scene-turbine	MeshTranslatedEvent	2017-03-12 18:18:52
13	13@scene-turbine	MeshAddedToSceneEvent	2017-03-12 18:18:52
12	12@scene-turbine	MeshScaledEvent	2017-03-12 18:18:52
11	11@scene-turbine	MeshRotatedEvent	2017-03-12 18:18:52
10	10@scene-turbine	MeshTranslatedEvent	2017-03-12 18:18:52

Results - Events

Events by type (upper)
Events by participant (lower)





Results - Questionnaire

- Positive feedbacks about latency and consistency
- Speed and efficiency improved collaboratively
- Scene recovery : satisfying

Discussion

- Network instabilities : quick recovery, transparent to user
- Easy to use : goal reached
- Easy to analyse : data traceability

Conclusion

- Web-based 3D collaborative design
  - Light, resilient and scalable
  - Business logic based, history awareness and data traceability
  - Loosely coupled 3D visualisation and interaction
- Future works :
  - improve (global & local) sync mechanisms for long term consistency
  - intelligent event distribution : based on user interest, topic (TERA [Baldoni2007])

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