Integration Examples of In-Network Storage and P2P Applications

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Objective

- A preliminary trial design to evaluate the feasibility of using in-network storage with P2P applications
- Application-agnostic storage server + application-specific control logic
  - Integration with two P2P applications
    - Vuze (a popular BitTorrent file-sharing client; plug-in style integration limits software flexibility)
    - PPNG (a P2P live streaming system based on PPLive, maintained at Yale)
- *We are not pushing the protocol we used as DECADE design. It is a design exercise.*

Background: In-network Storage Capabilities

- Users have accounts on the in-network storage servers

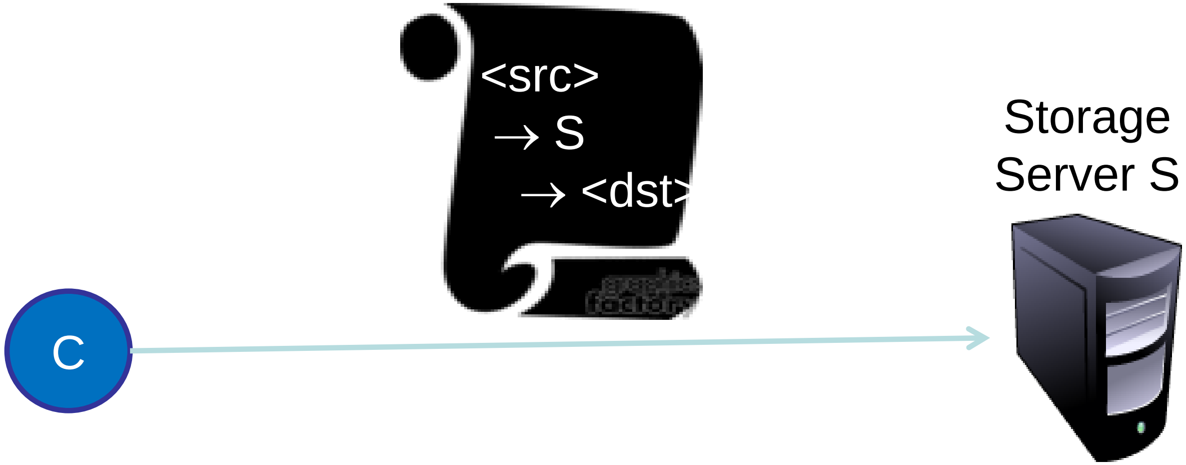
In-network storage server S

- Apps (exec'd by users) send requests to servers using token based access control

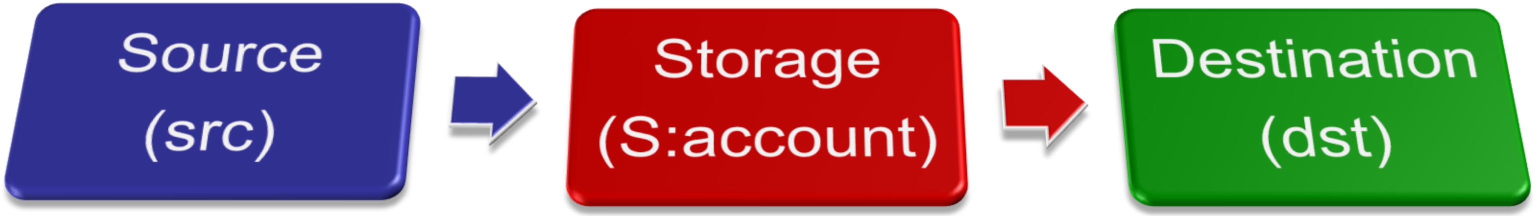
- Data object identified by hash of its content

Background: The Basic `Distribution` Primitive

- A basic data command primitive is to indicate a data path

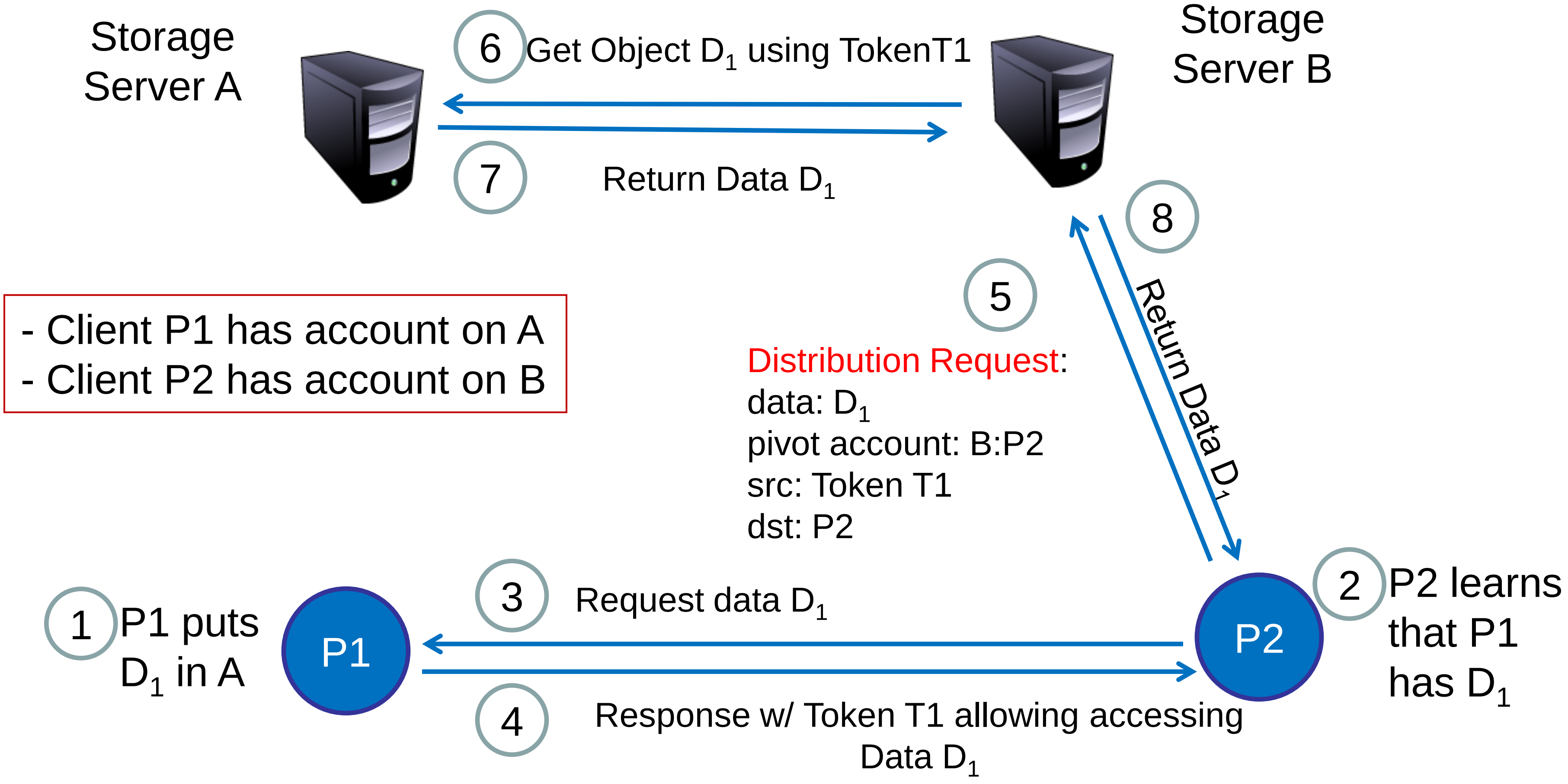


Background: The Basic `Distribution` Primitive



- The data path primitive from Client C to server S specifies
    - <data id>,
    - a <src>,
    - an account on S <S:account>, and
    - a <dst>.
  - Interpretation
    - If <src> is null: it is a pure read to transfer data from <S:account> to <dst>
    - If <dst> is null: it is a pure write to store data from <src> to <S:account>
    - Otherwise, it is a distribution pipeline from <src> to <S:account> to <dst>
- Write is deduplicated

Example: Endpoint Controlled Data Flow



Storage Server A

Storage Server B

6 Get Object D_1 using TokenT1

7 Return Data D_1

8 Return Data D_1

- Client P1 has account on A
- Client P2 has account on B

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Distribution Request:
data: D_1
pivot account: B:P2
src: Token T1
dst: P2

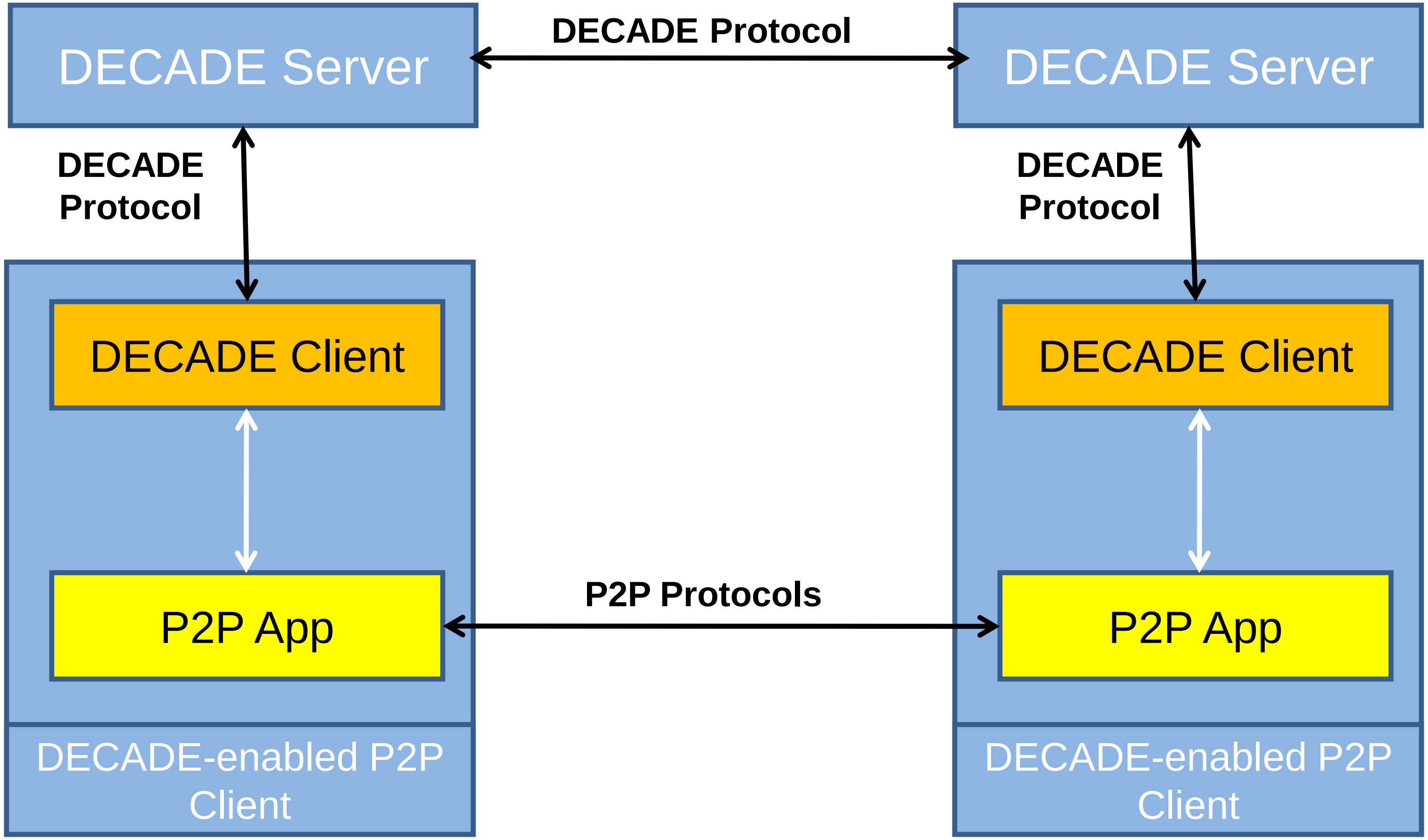
1 P1 puts D_1 in A

2 P2 learns that P1 has D_1

3 Request data D_1

4 Response w/ Token T1 allowing accessing Data D_1

Integration Overview



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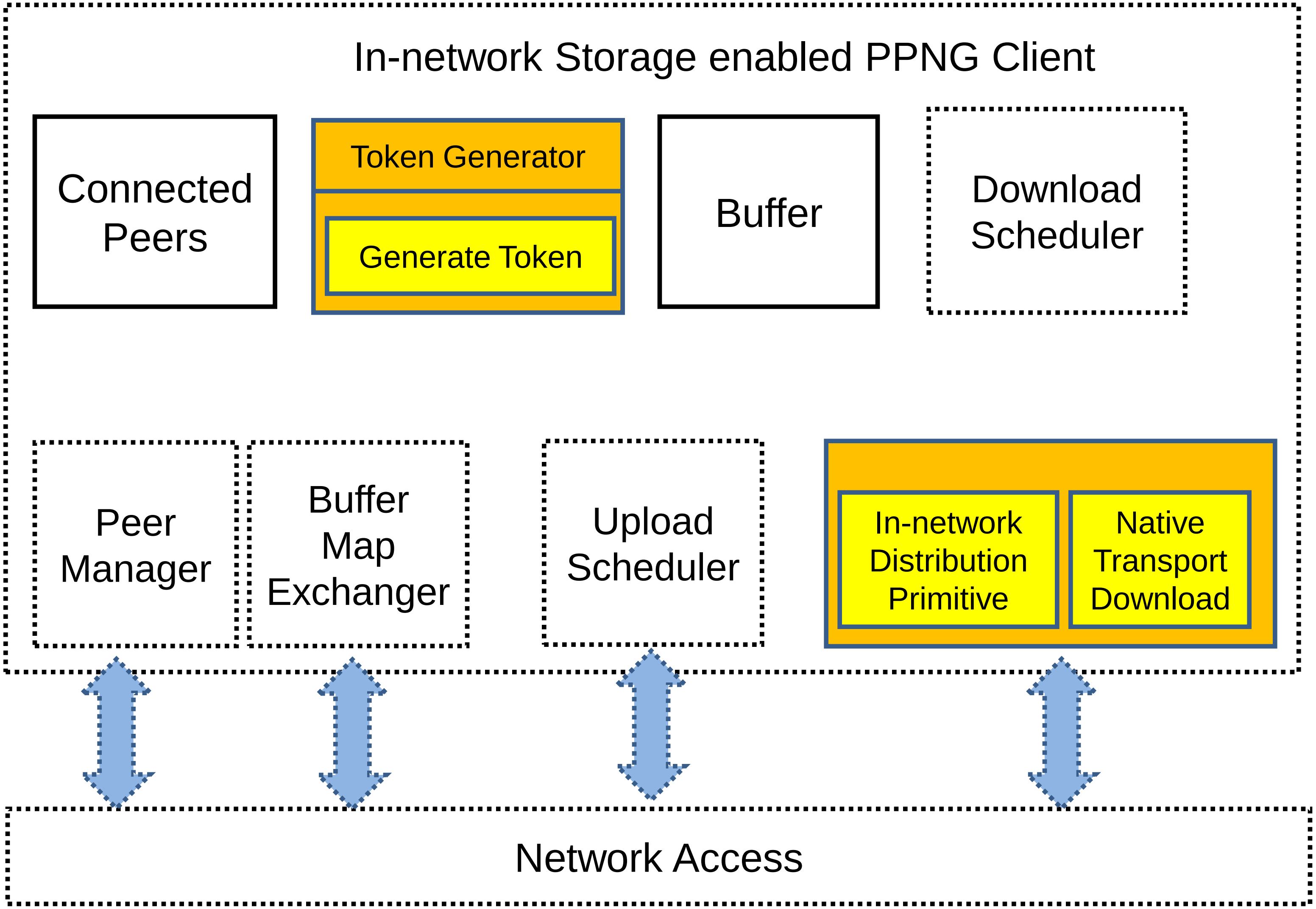
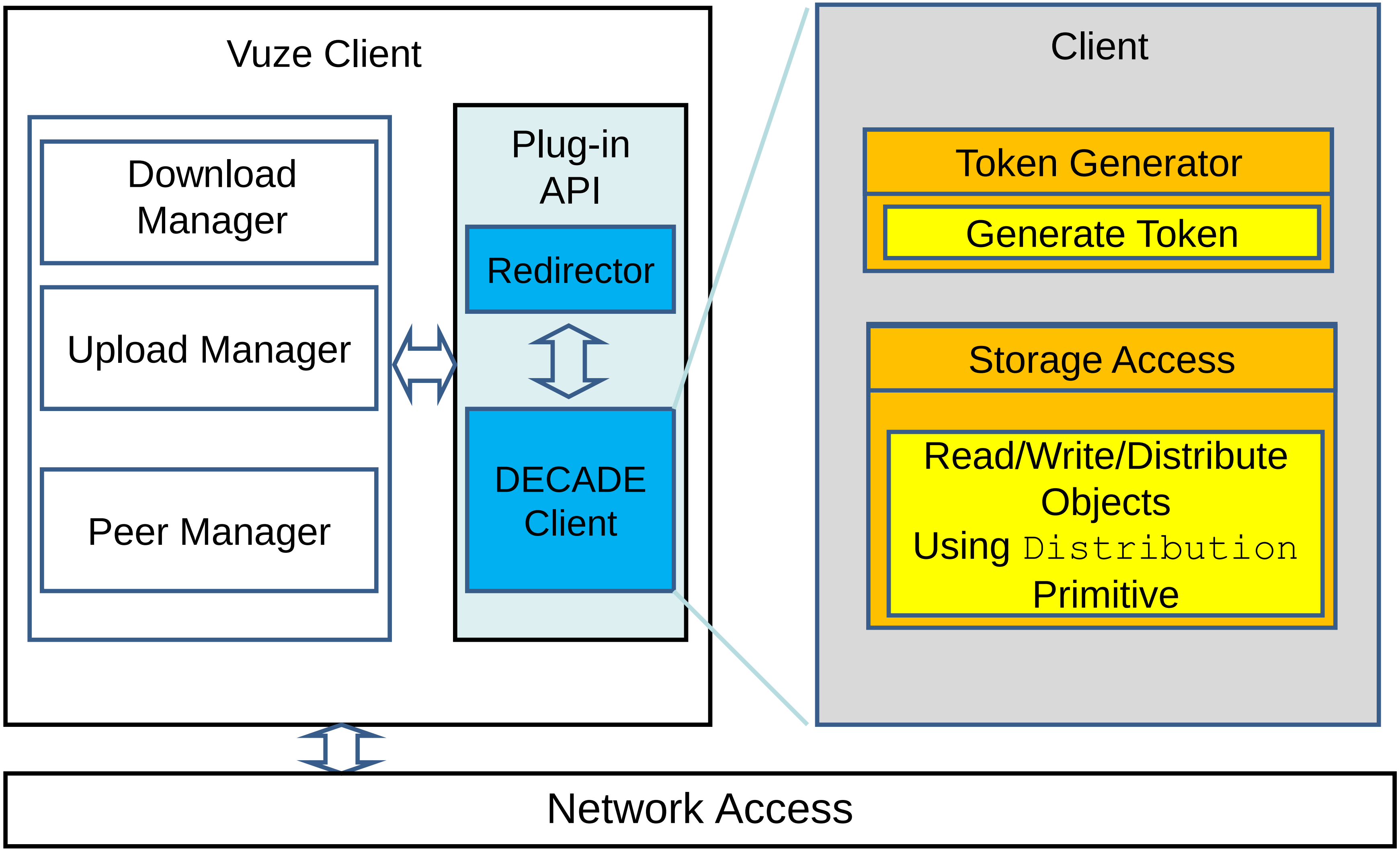
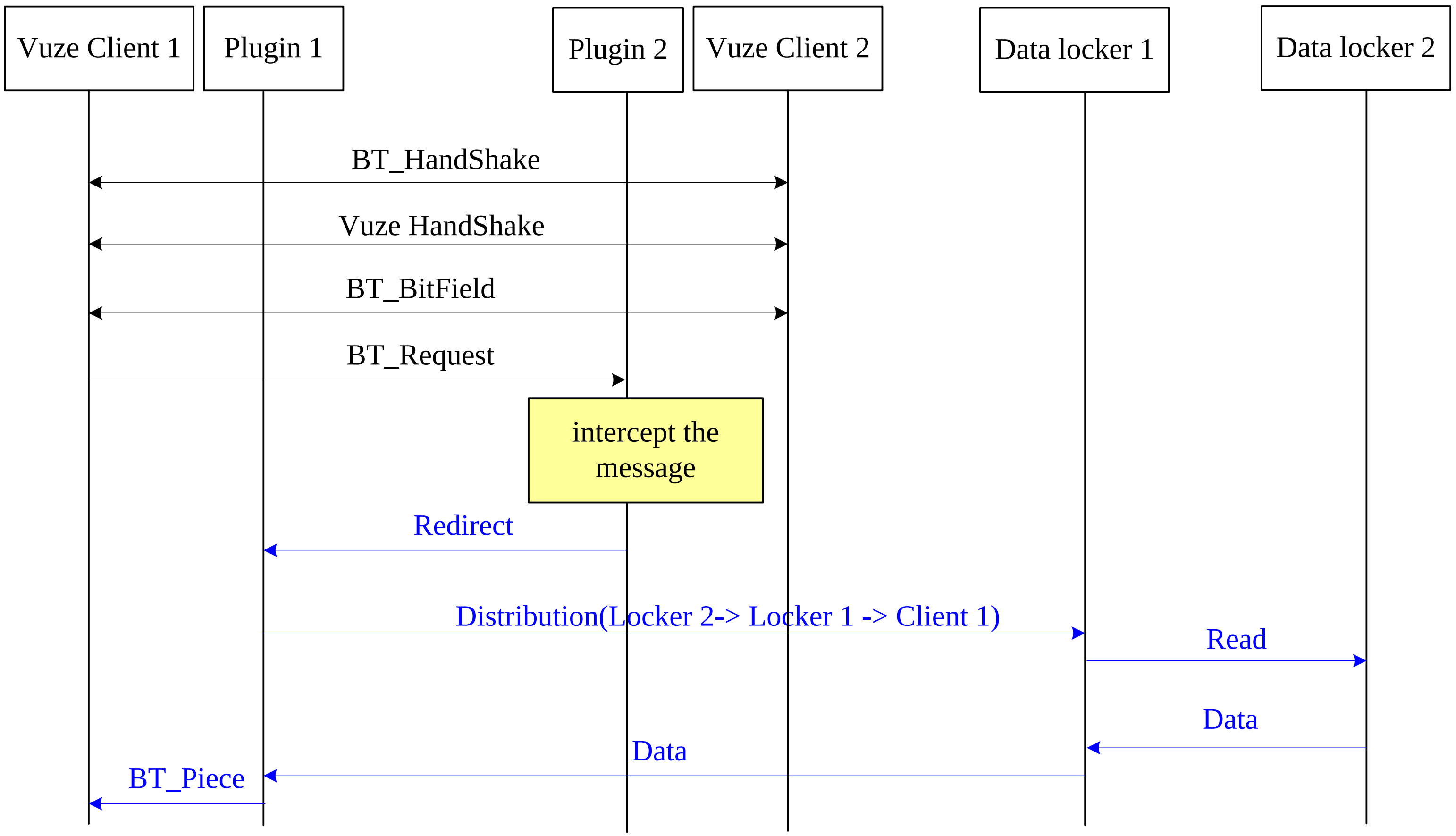
Integration Case 1: P2P Live Streaming



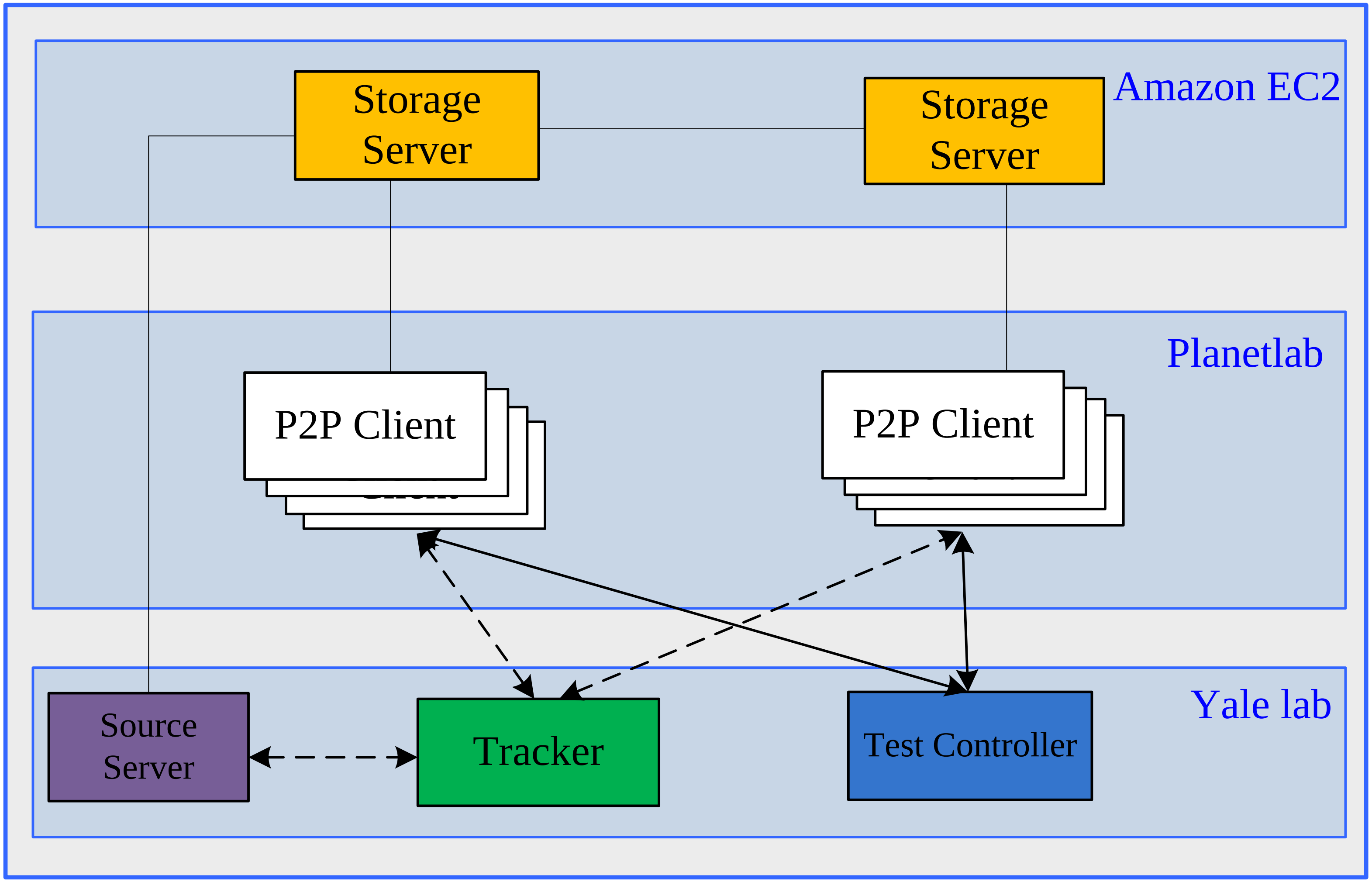
Integration Case 2: P2P File Sharing



Example: Data Request Flows of Vuze with Storage



Experimental Setting



Results: P2P Live Streaming

	Improvement with In-network Storage
Startup delay	At 80-percentile: reduced to 2/3 when no storage
Piece lost rate	About the same, at ≤ 0.02%
Average # of freezes	Reduced to 2/3 when no storage

Results: P2P File Sharing

	Improvement with In-network Storage
Client upload volume	430 MB → 12 MB
System resource efficiency*	65% → 88% (35% speedup)

*System resource efficiency: fraction of total available upload capacity used

Thank you!