

Dynamic Intelligent Aggregation Services

Love and Strife in large-scale decentralized systems

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PhD Candidate

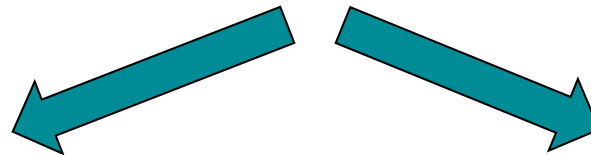
Faculty of Technology, Policy & Management

Systems Engineering Section

PhD Research

Distributed Computing

Multi-level Reconfigurable Self-organization
in **Overlay Services**



Dynamic Aggregation Services

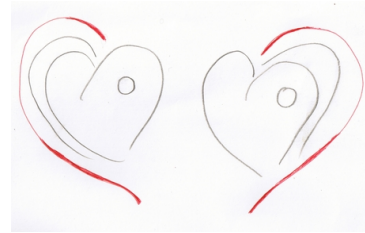
Tree Self-organization Services



Demand-side Energy Management



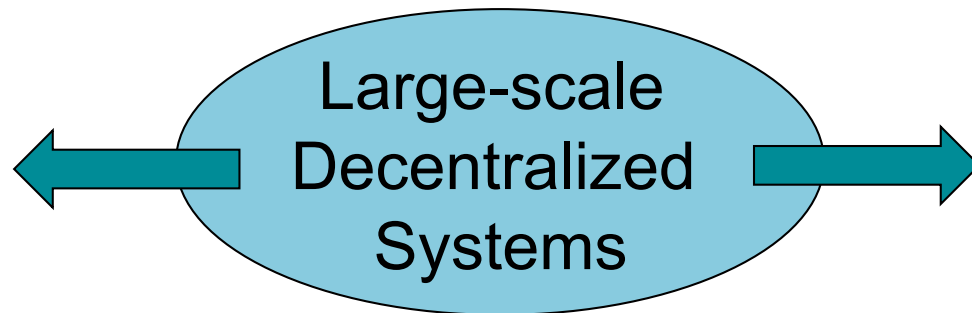
Love and Strife



"These (elements) never cease changing place continually, now being all united by Love into one, now each borne apart by the hatred engendered of Strife, until they are brought together in the unity of the all, and become subject to it."



Continuous
Information
Change



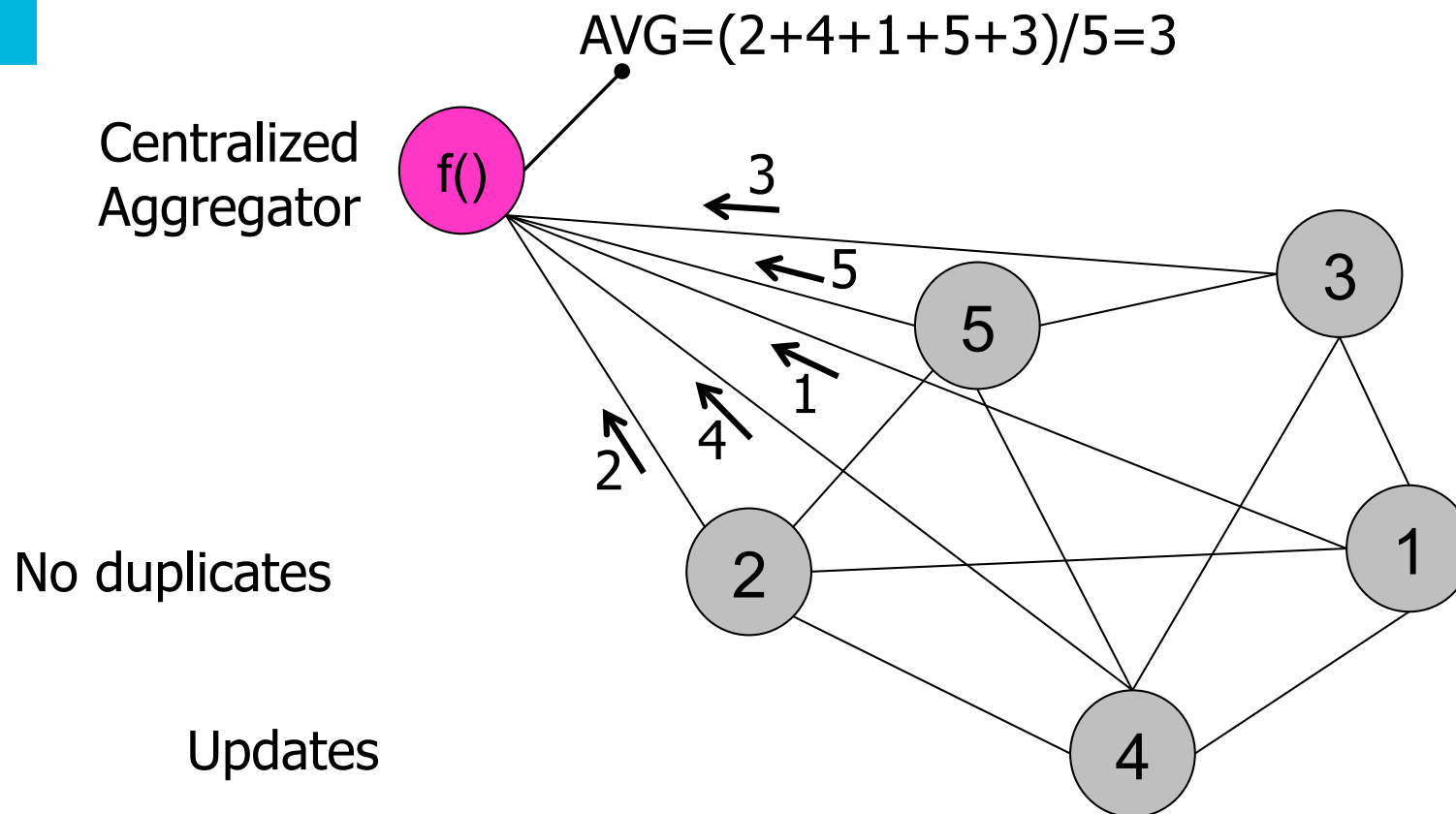
Accurate
Information
Aggregation

Local

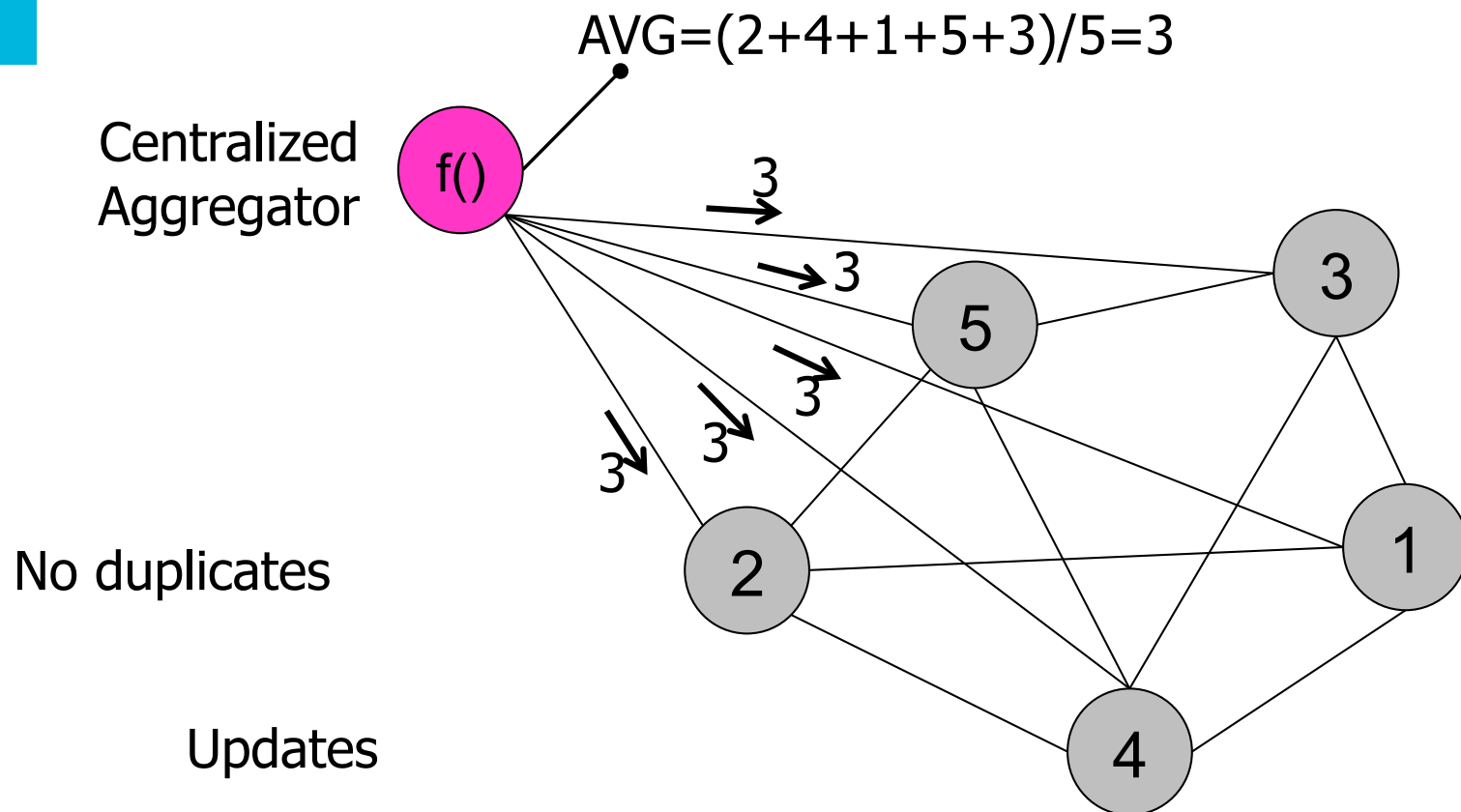


Global

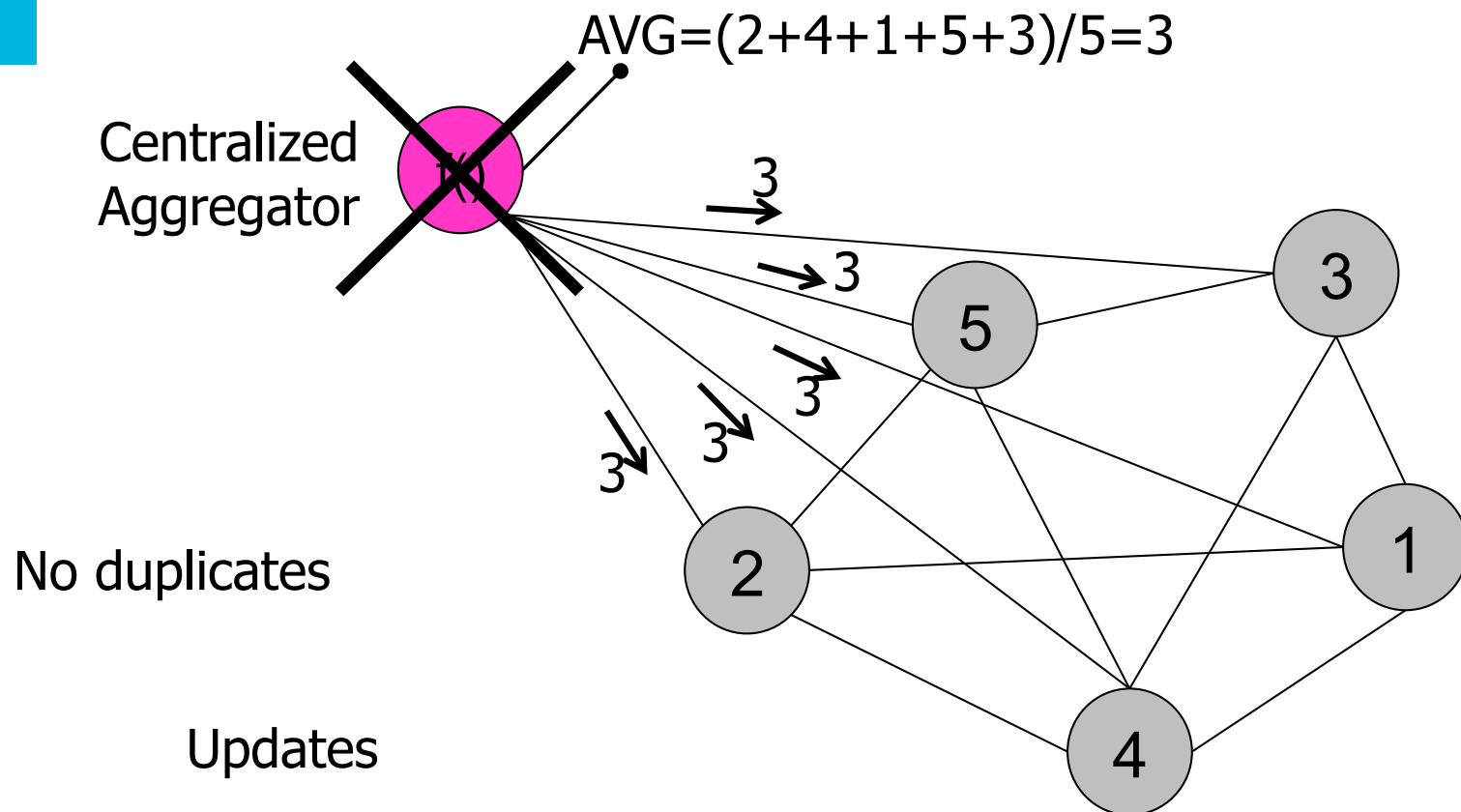
The Aggregation Problem



The Aggregation Problem

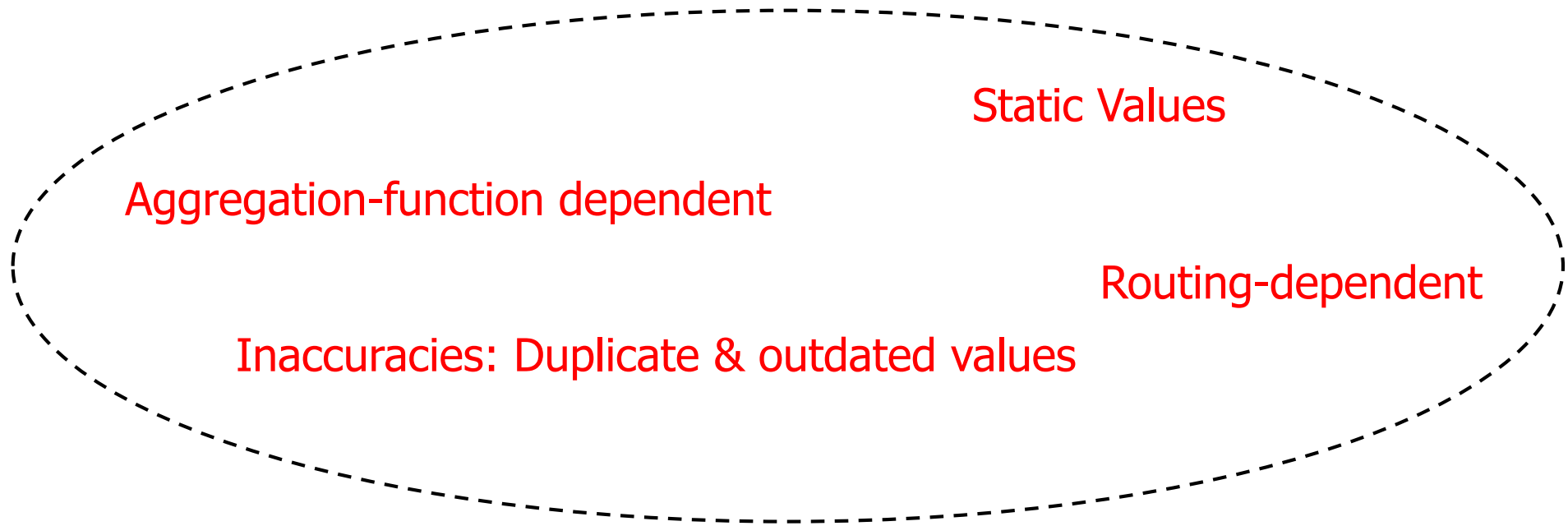


The Aggregation Problem



Decentralized Aggregation

Gossip-based Aggregation



Tree-based Aggregation

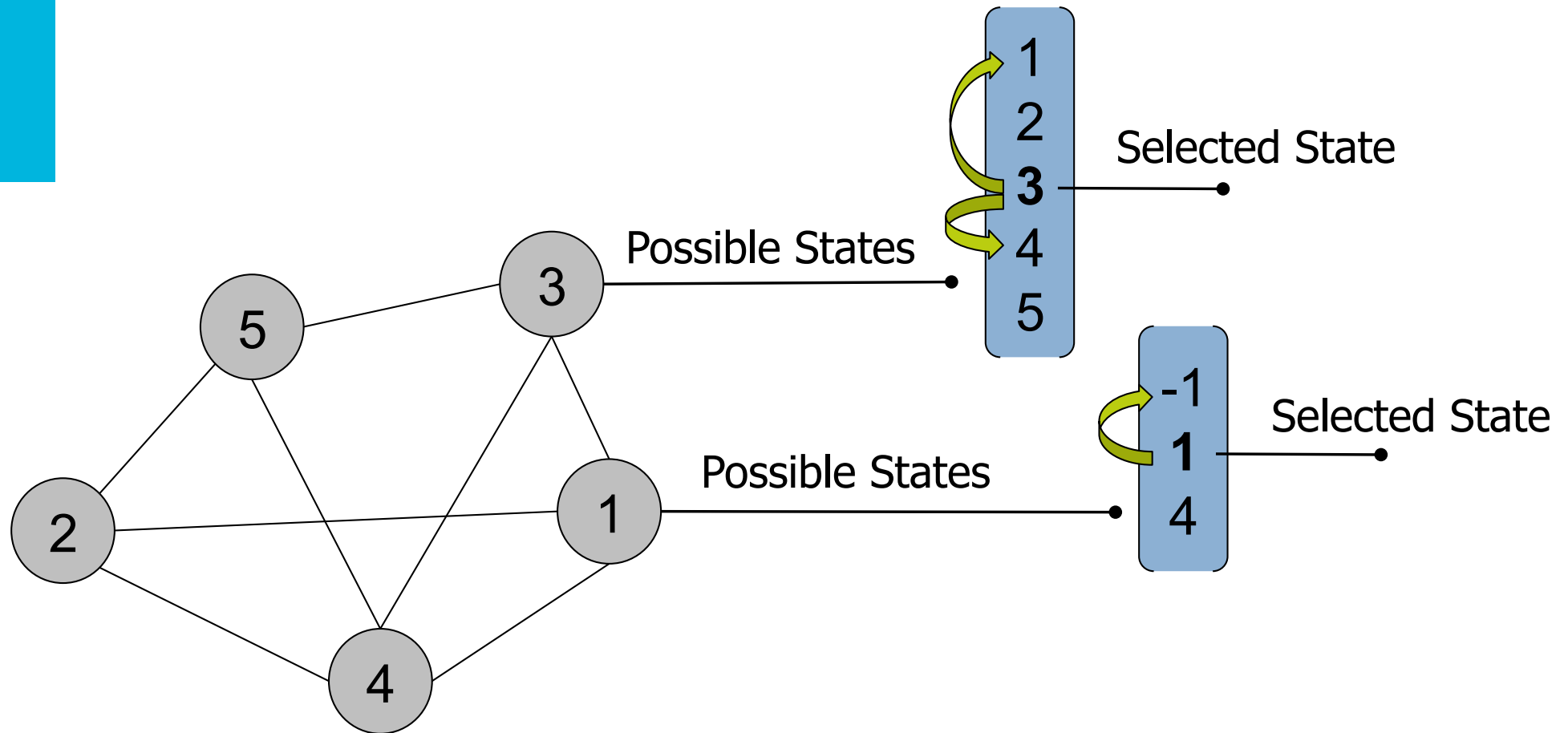
Synopsis Diffusion



Decentralized Aggregation (Cont.)

DIAS – Dynamic Intelligent Aggregation Service

Modeling of Dynamics



of Possible Aggregates = # of possible states^{# of Nodes} = $3^{10} = 59049!$

Applications

Recommender Systems

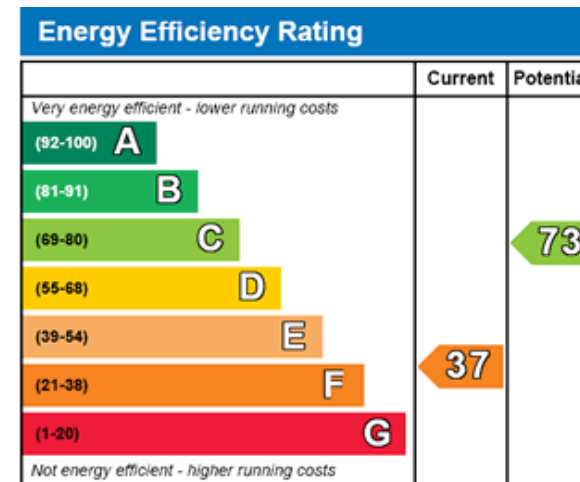
The screenshot shows a movie recommendation interface for 'Witchblade'. At the top, there are five star rating options with a 'Not Interested' button. Below this, there are five buttons labeled 'Click to rate the movie "Hated It"', 'Click to rate the movie "Didn't Like It"', 'Click to rate the movie "Liked It"', 'Click to rate the movie "Really Liked It"', and 'Click to rate the movie "Loved It"'. The movie title 'Witchblade' is displayed above a character image. Below the image is an 'Add All' button and a star rating section. The star rating section shows a current rating of 2.8 (indicated by a red box) and a customer average of 3.7. A red arrow points from the 2.8 rating to the star rating section.

adventure series.

Starring: Akemi Kanda, Mamiko Noto
Director: Yoshimitsu Ohashi
Genre: Anime & Animation
Rating: TV-MA

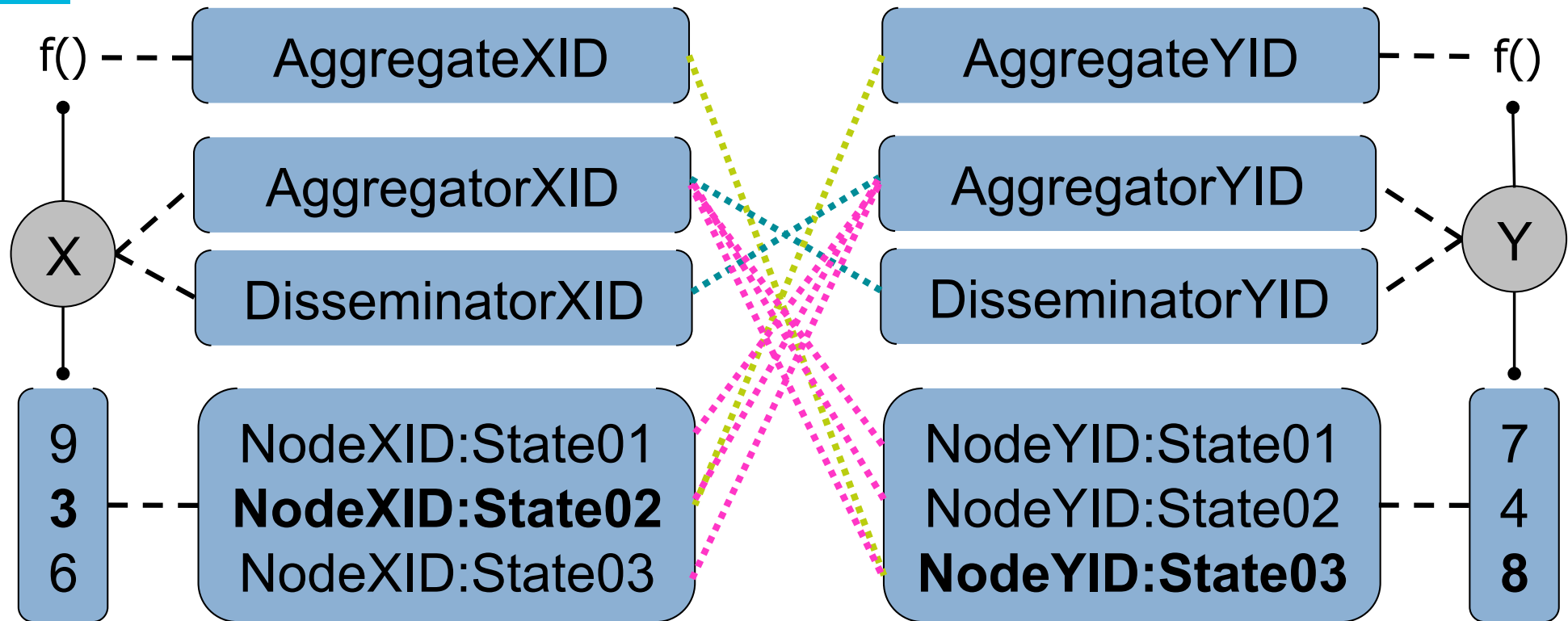
★★★★★ **2.8** Our best guess for Riyadh
★★★★★ 3.7 Customer Average

Smart Energy Systems



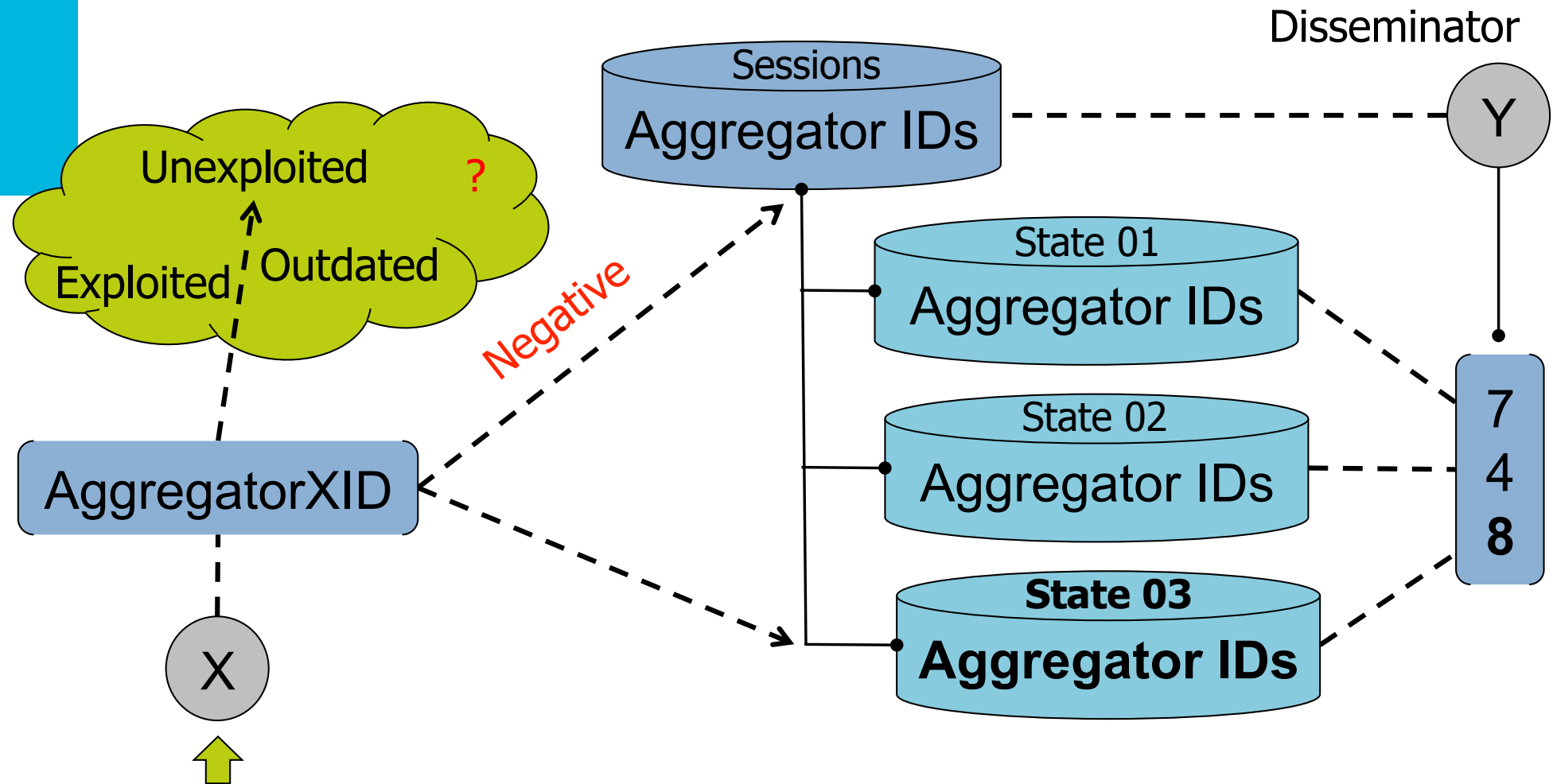
Mutual Aggregation Memberships

Node: Aggregator and Disseminator



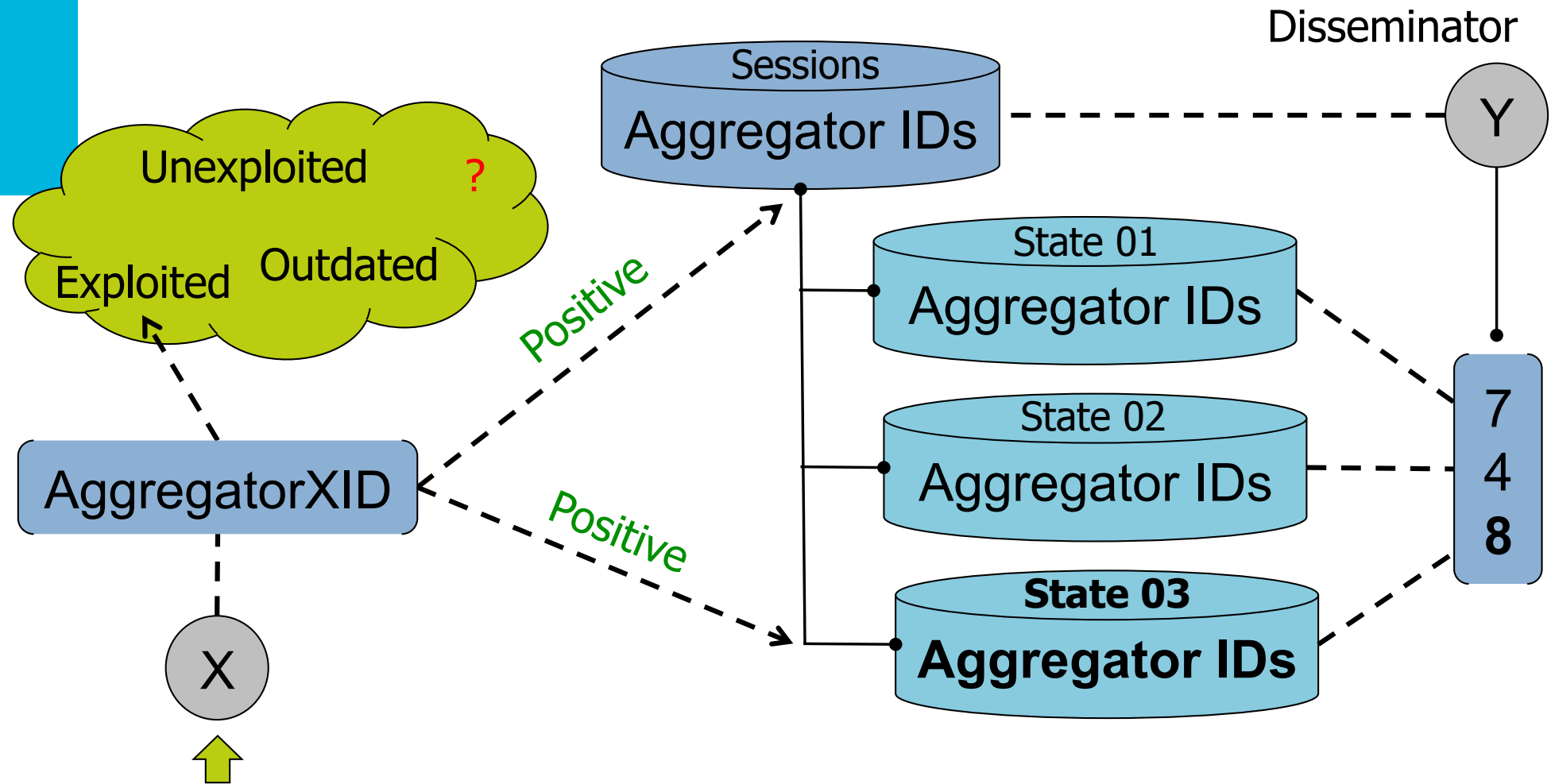
Aggregation Session

Classification



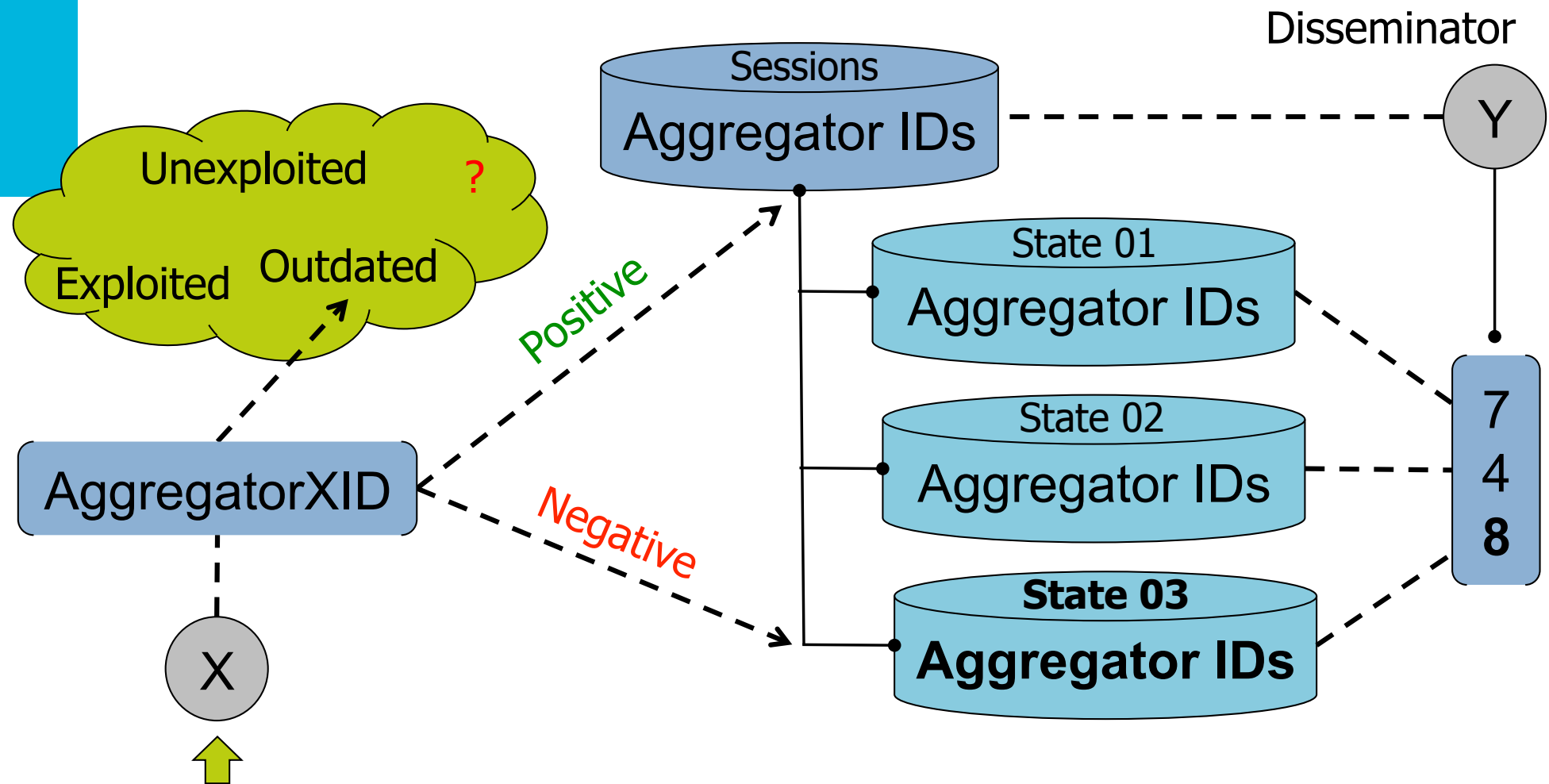
Node Sampling (gossiping, flooding, walkers)

Classification



Node Sampling (gossiping, flooding, walkers)

Classification



Aggregation Memberships

Can we **explicitly** store aggregation memberships in a decentralized system?



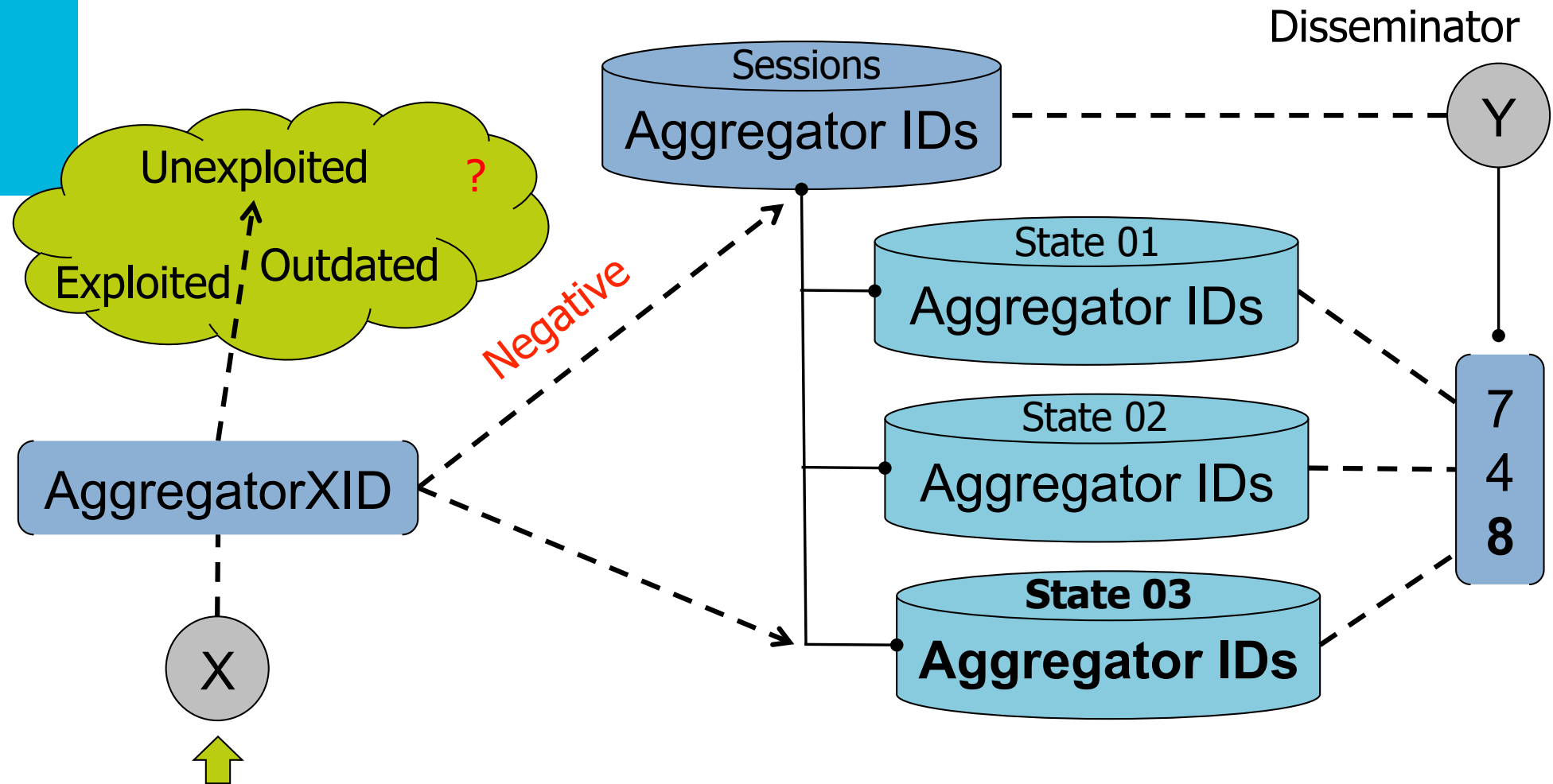
Can we overcome this problem?

Yes, with the **Love** and **Strife** of **bloom filters**

Probabilistic data structure

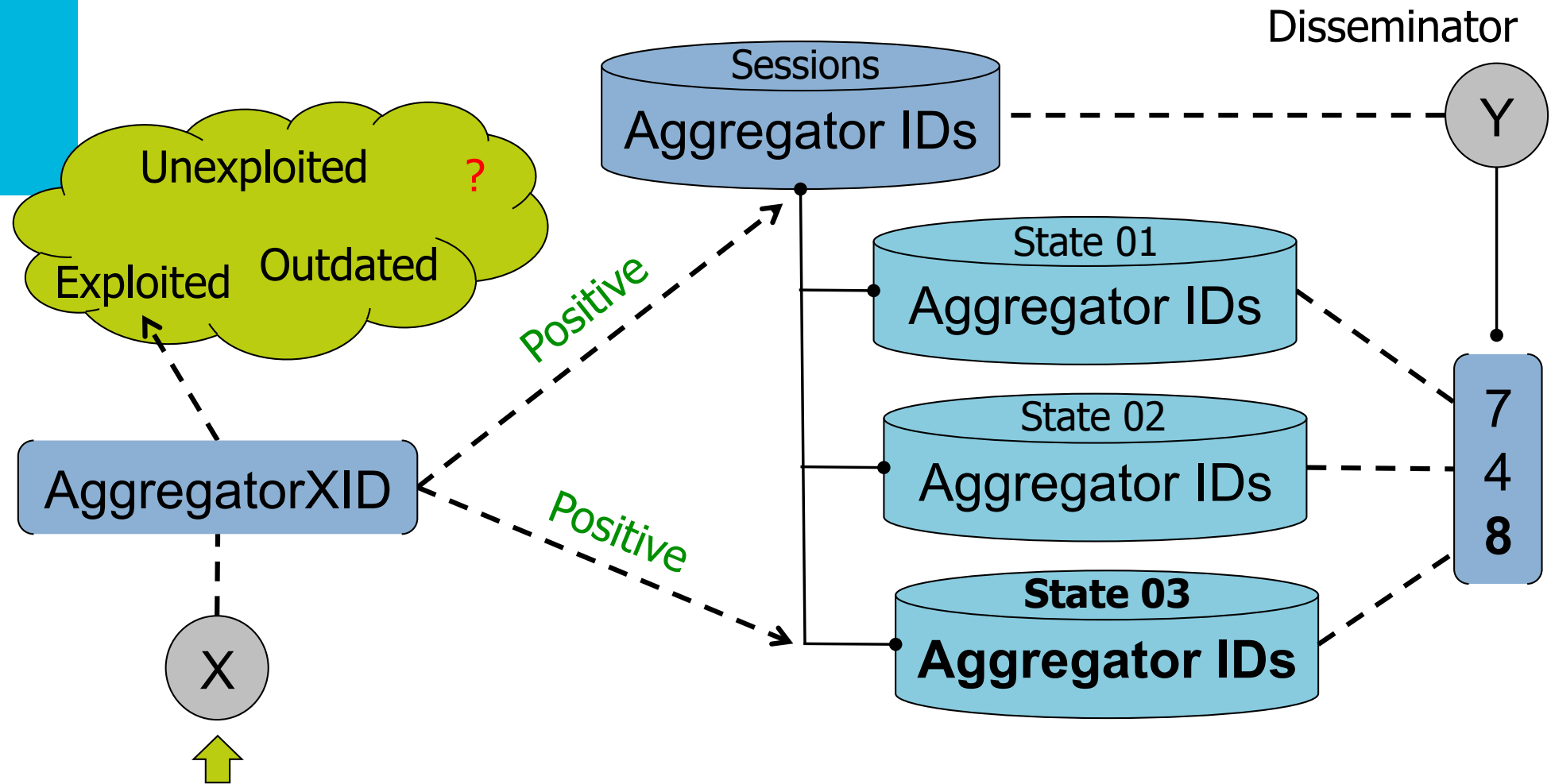
Large **space savings** at a cost of **false positives**

Classification

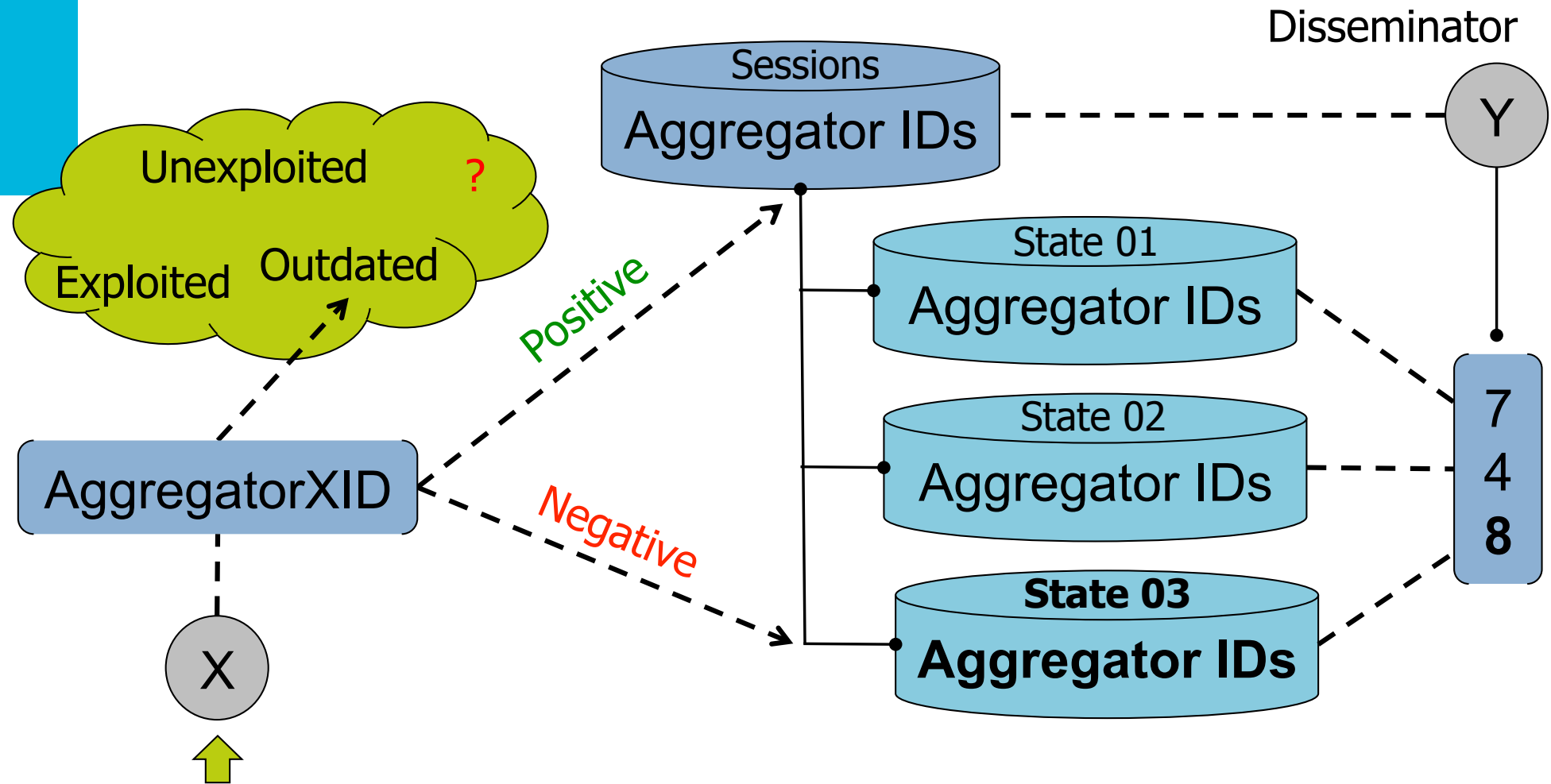


Node Sampling (gossiping, flooding, walkers)

Classification



Classification



Bloom Filters

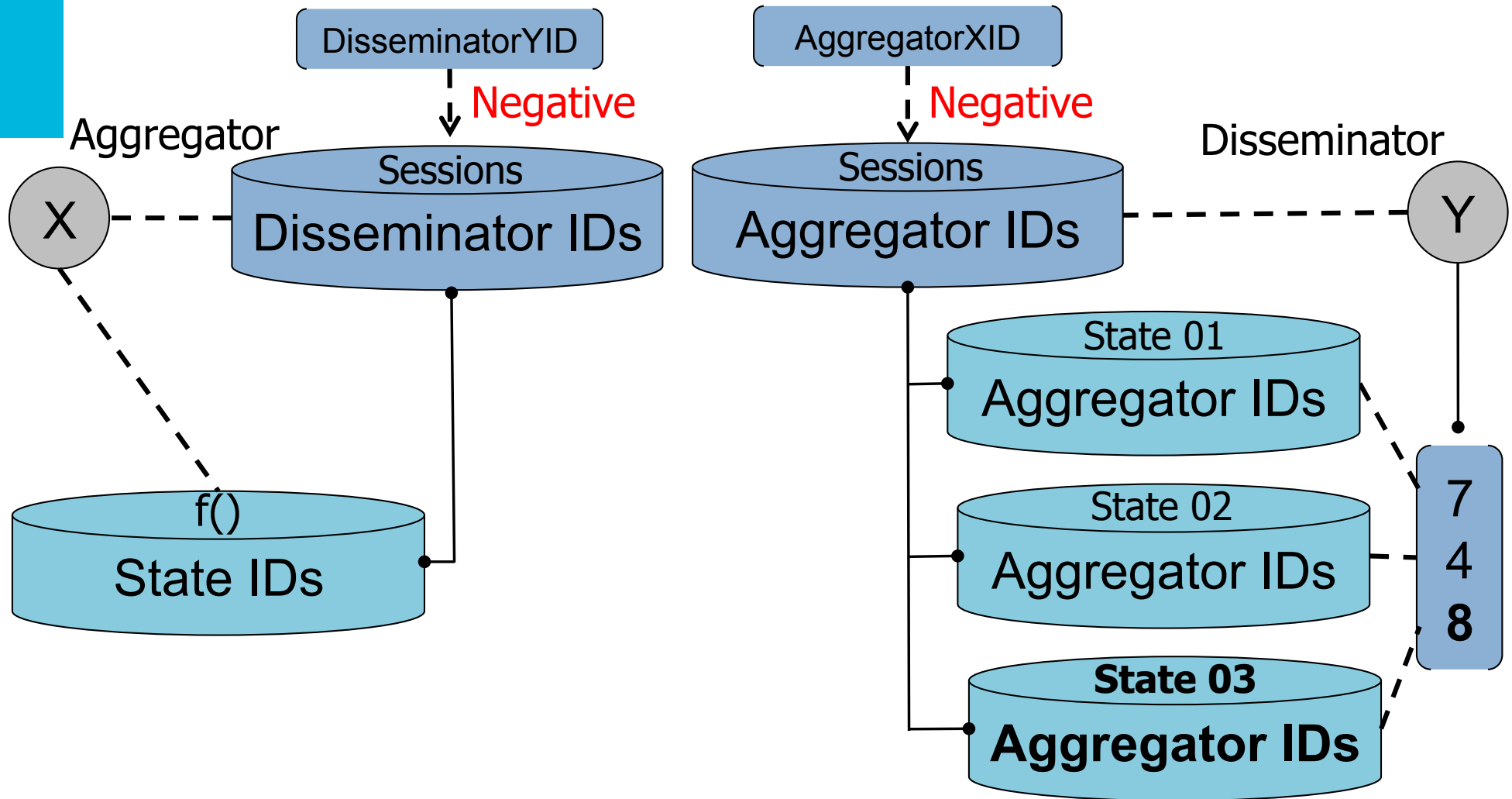
Inconsistent aggregation sessions are possible!

Goal: Minimization of aggregation inaccuracies due to false positives

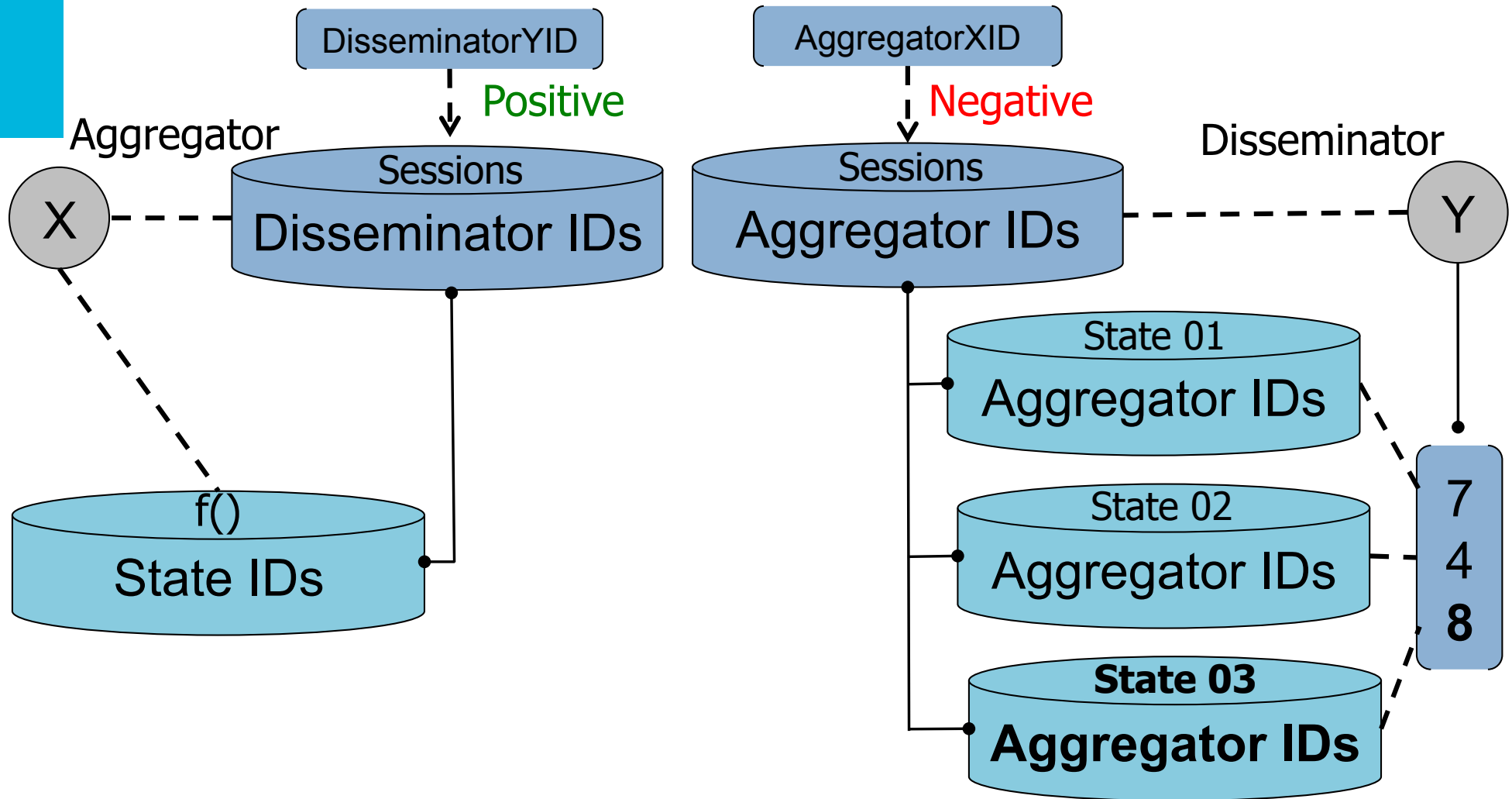
How?

Mutual membership checks!

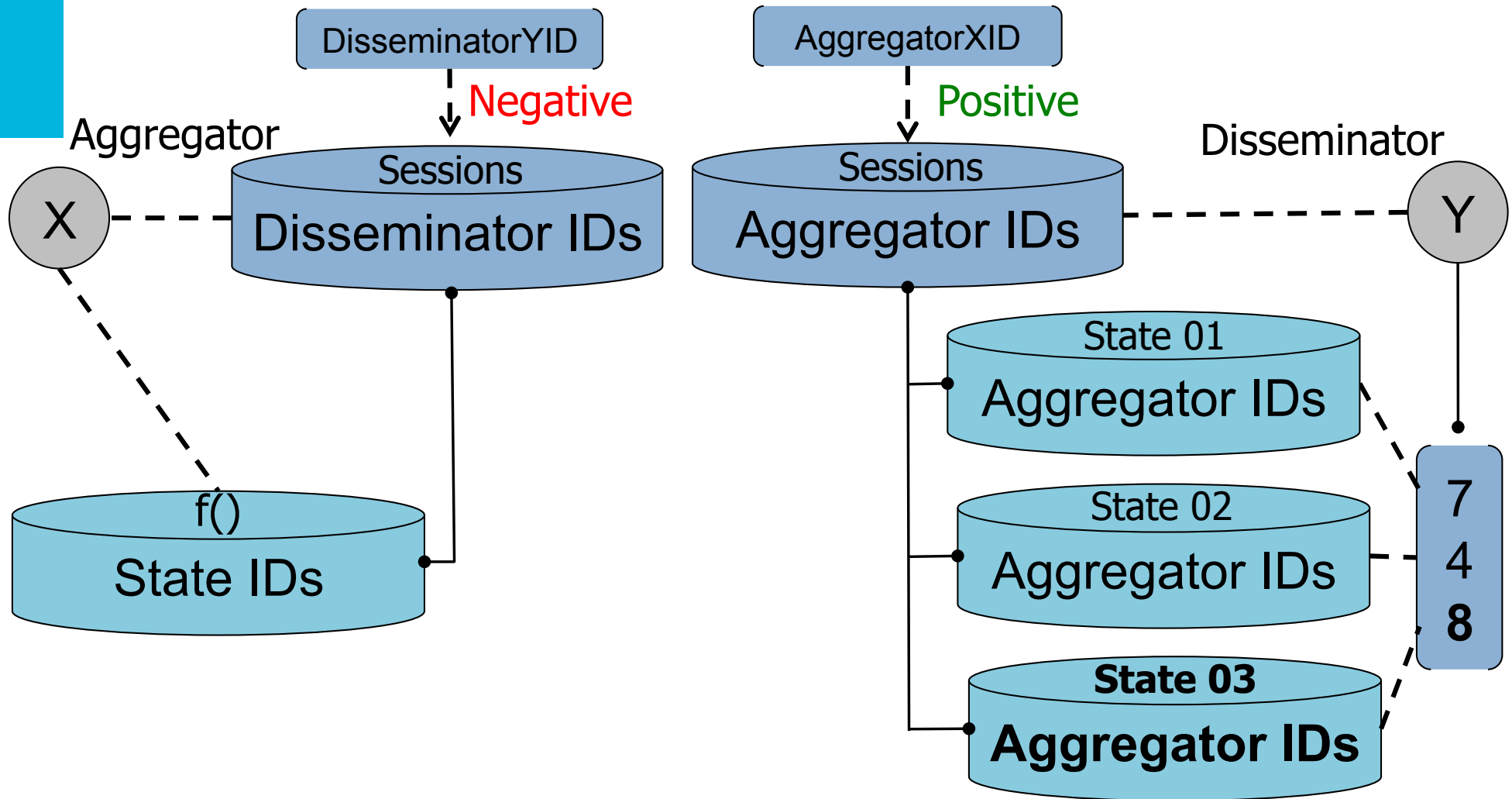
Mutual Membership Checks



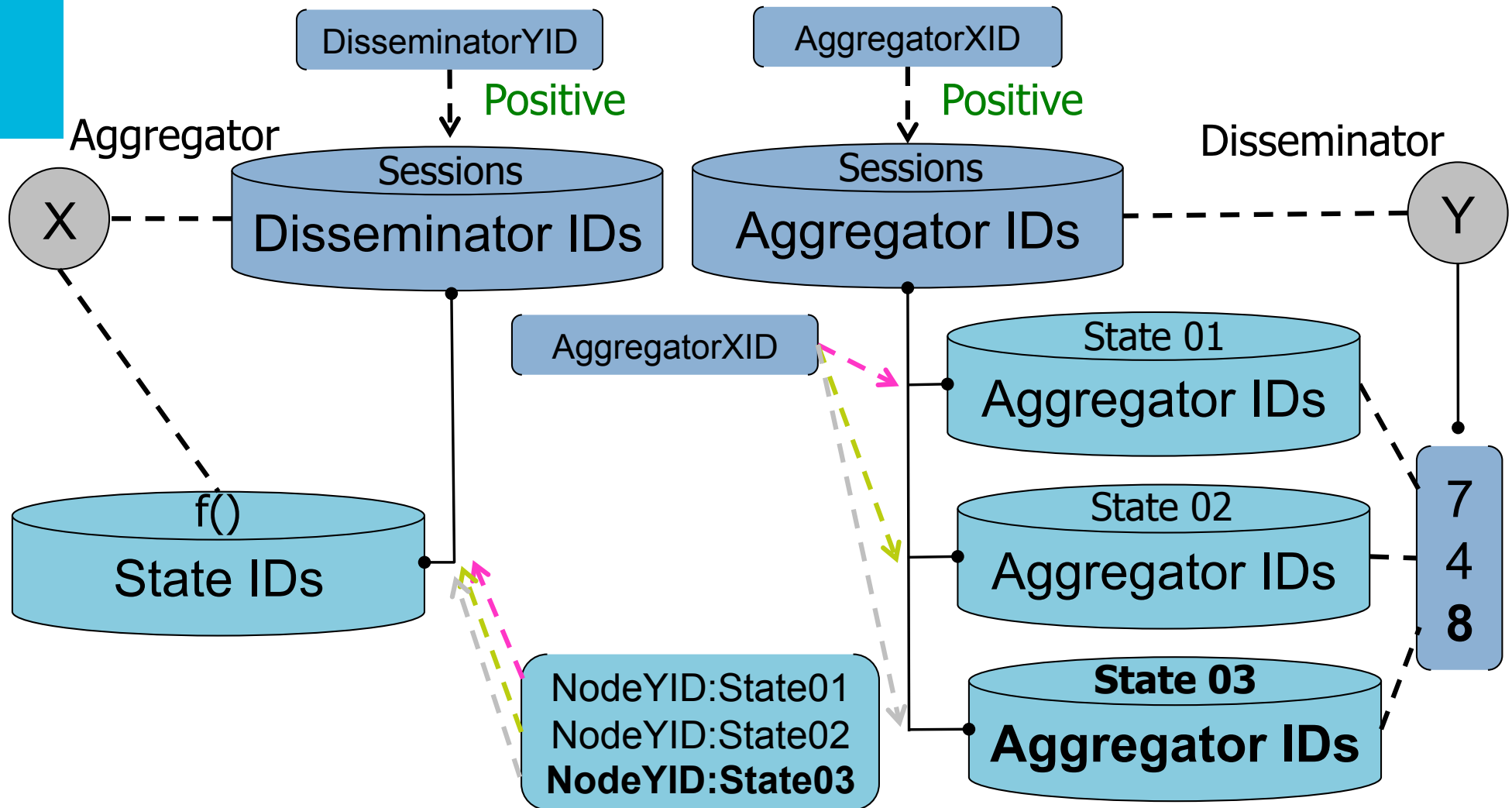
Mutual Membership Checks



Mutual Membership Checks



Mutual Membership Checks



Evaluation

DIAS prototype in Protopeer

XSiena Bloom Filter implementation

Node sampling: Gossiping (Peer Sampling Service)

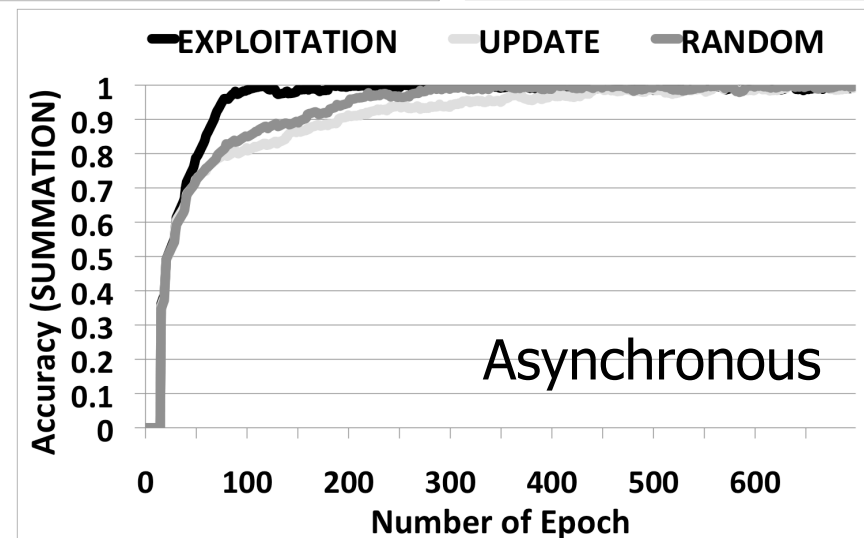
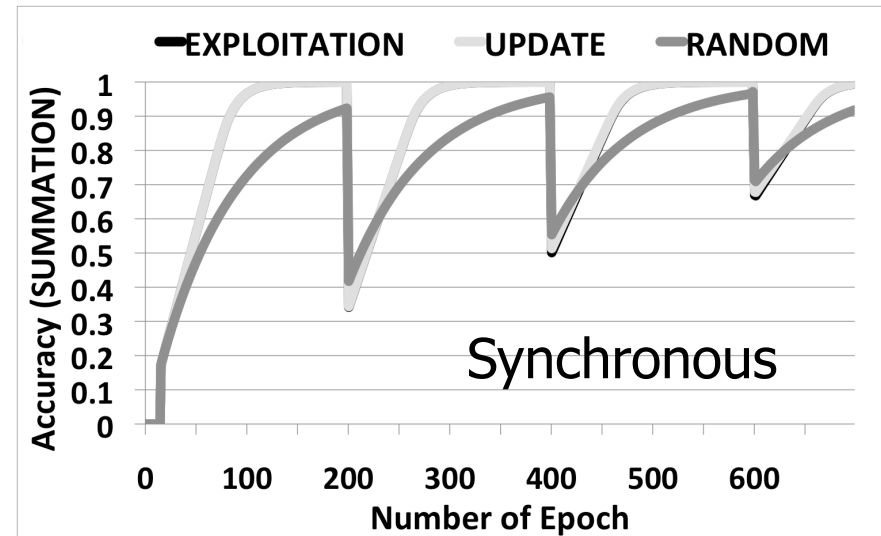
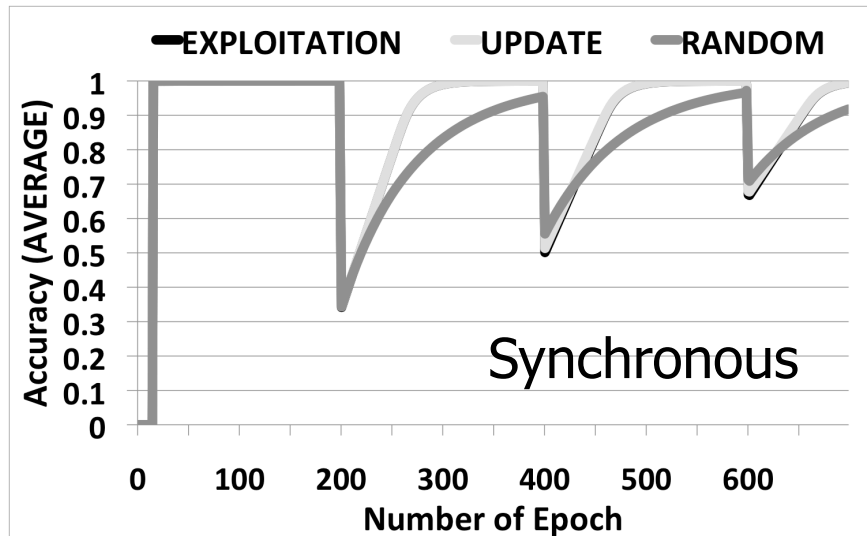
Large-scale network: 1500 nodes

5 possible states/node

Synchronous/asynchronous state changes

Aggregation strategies: EXPOITATION, UPDATE, RANDOM

Evaluation

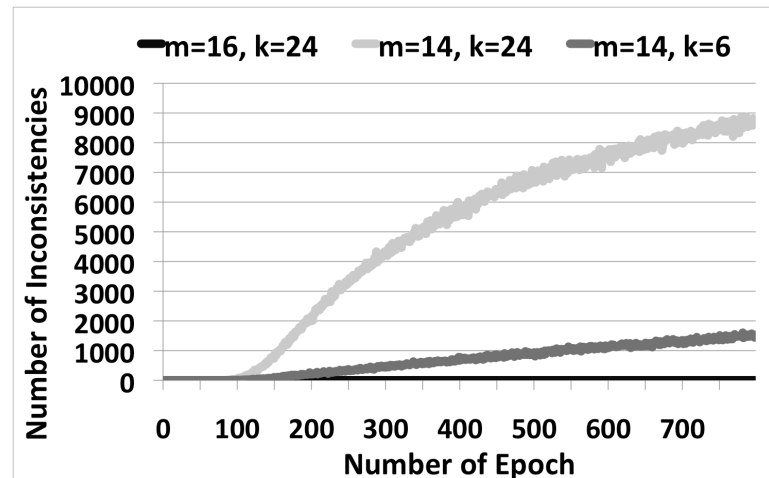


Evaluation (cont.)

No influence in accuracy under false positive

Why?

Inconsistencies are detected by **mutual membership checks**





Conclusions

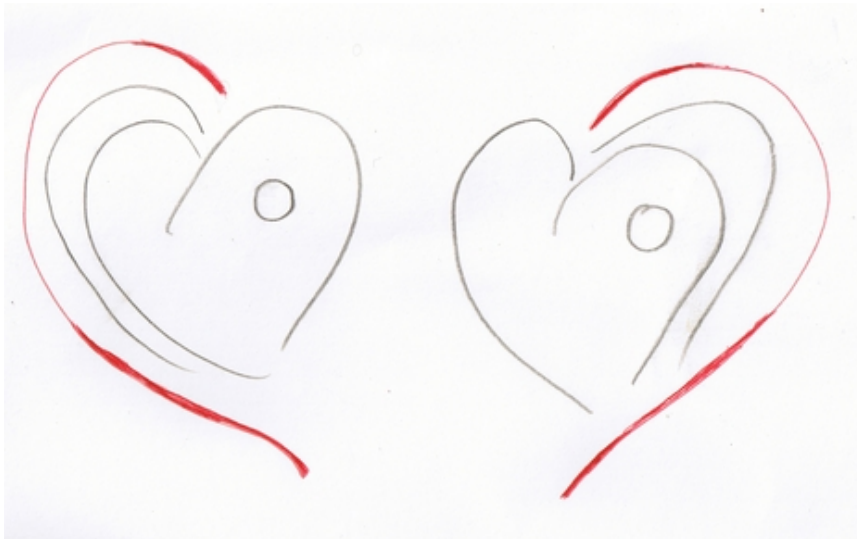
Generic-Multiple aggregation functions

Dynamically changing values

Inaccuracies are minimized: Detection of duplicate and outdated values

Mutual memberships checks: False positive tolerance

Questions?



More information

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