Efficient In-Network Evaluation of Complex Event Processing Queries

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Evaluate CEP query...  ...in Event Network...  ...such that:

\[ q : \text{SEQ}(A,a, D,d, C,c) \quad \text{WHERE} \quad a.x < c.y \quad \text{WITHIN} \quad 30 \text{ sec} \]

\[ r(A) < r(B) < r(C) \]

- network transmission costs minimized
- given Latency bound respected

In-Network Evaluation Graphs

Query Splitting:
- split query into projections
- construct results using combinations of projections

Multi Sink Placements:
- partition generation of projection matches over multiple nodes

Output Selection:
- send only partial results of projection matches

Tree-based Forwarding:
- employ Steiner Tree based routing of events

Result Sharing:
- reuse projections & share routing trees in multi-query scenario

Experimental Setup
- simulation study with synthetic data sets
- varying query and network parameters (network size, selectivities, query length, event skew)
- implementation of prototype CEP engine for execution of In-Network Evaluation Graphs

Experimental Results:
- comparison against state-of-the-art
- single query results
- multi-query results
- trade-off latency and network costs

Take Away
- In-Network Evaluation Graphs reduce network transmission costs up to 8 orders of magnitude compared to centralized evaluation
- reducing network transmission costs, reduces processing latency but potentially increases communication latency

Previous Results:
- Samira Akili and Matthias Weidlich. MuSE Graphs for Flexible Distribution of Event Stream Processing in Networks. In SIGMOD '21
- Samira Akili and Matthias Weidlich. Reasoning on the Efficiency of Distributed Complex Event Processing. Fundam. Informaticae 179