IOTA-based Micropayment of IoT Data

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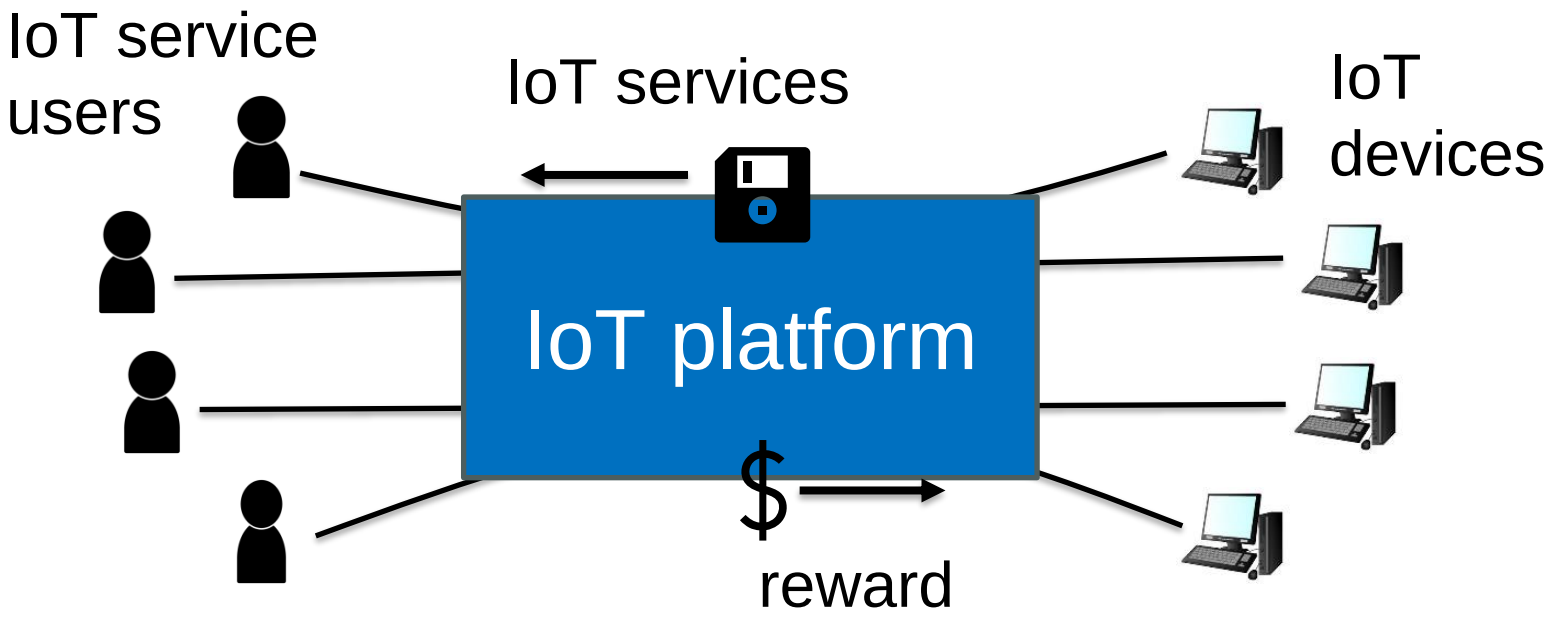
Micropayment in IoT Services

- Users of IoT service frequently receive services.
- Frequent small payments occur between service users and service platforms.



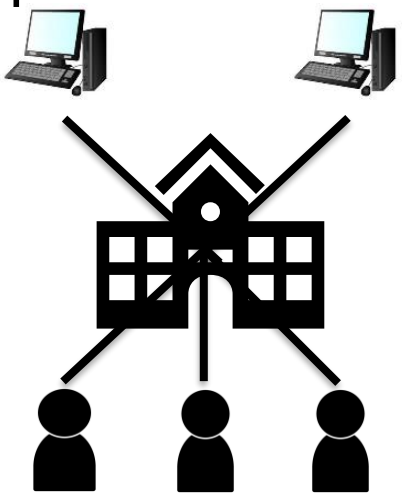
Micropayment Using Distributed Ledger Technology

- When payment is processed by single entity (centralized), single entity can falsify processing.

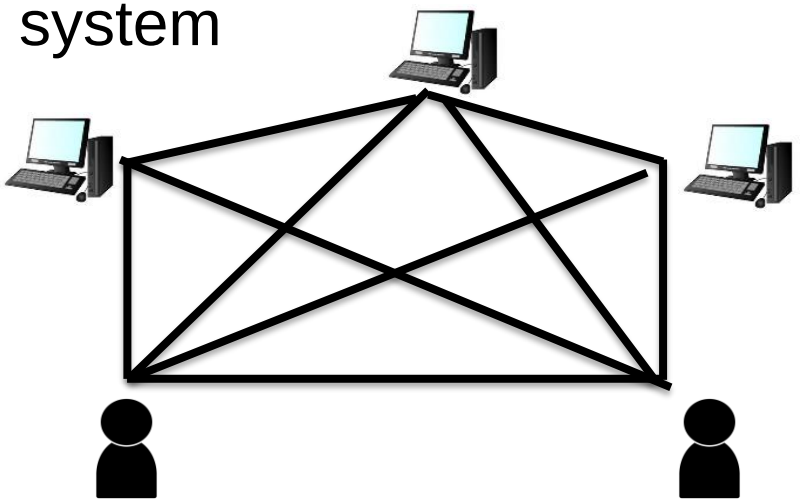
Payment processing by distributed ledger technology

→Blockchain, IOTA

centralized system



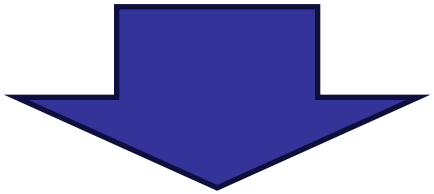
distributed system



Purpose of This Work

- Micropayment with small transactions

  → High fees are issue when using blockchain



- Apply IOTA, highly scalable distributed ledger technology, to IoT micropayment
  - No transaction fees by using IOTA
  - Lighter processing and smaller latency than making payments in bulk

IOTA

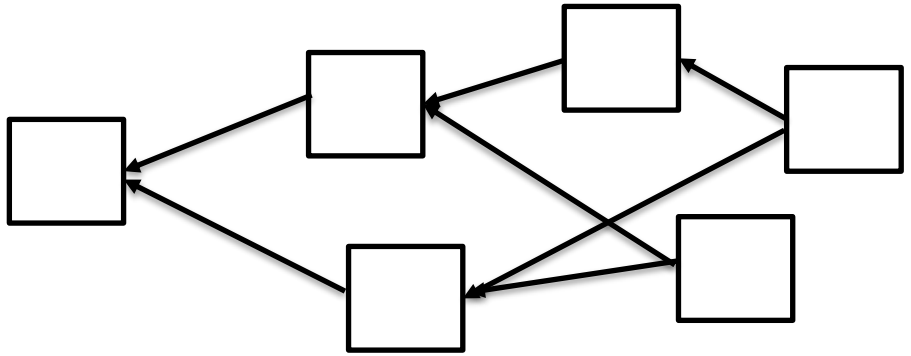
- Distributed ledger technology
  - No transaction fees

    → Low cost
  - High transaction processing speed

    → High scalability

- Directed acyclic graph (DAG) structure
  - New transaction selects two existing transactions.

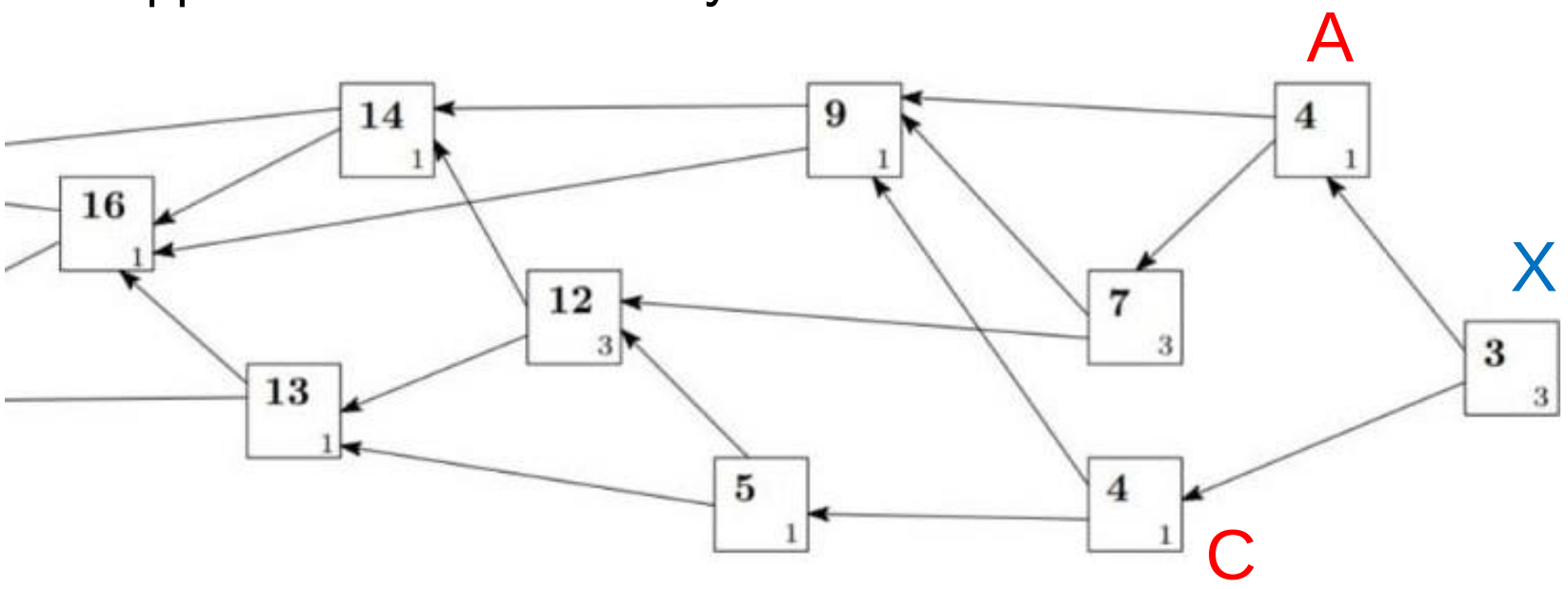
    → Approval



Tip

- Tip
  - Unapproved transactions in DAG, tangle graphs

- When new transaction X arrives
  - Transaction X authorizes A and C
  - The cumulative weight of other transactions that receive approval is increased by 3



How to Search for DAG

- Need to search for previously approved transactions
  - Transaction information for own past transactions

- DAG Search Method
  - Hash chain method
  - Binary search tree

  → Manage prefixes and IDs
  → Direct access on DAG to obtain content names

  - Breadth-first search
  - Depth-first search

  → Search on DAG
  → Search ends upon discovery.

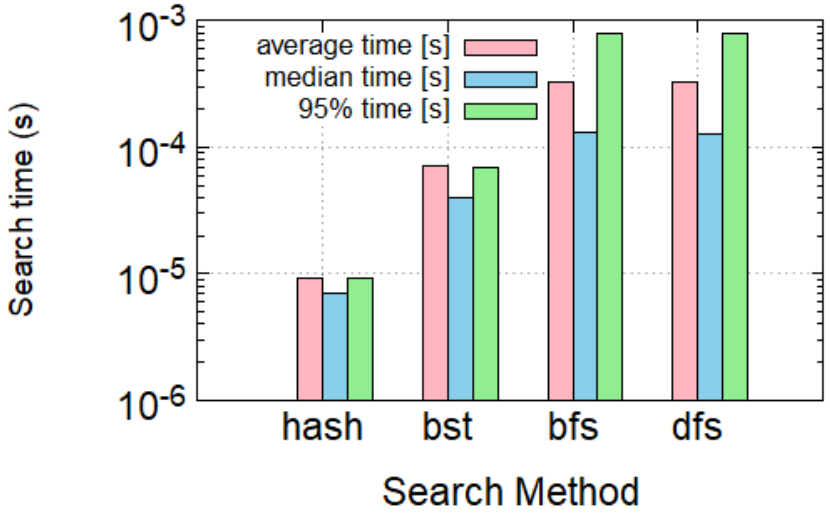
Tip Selection Algorithm

- Three tip selection algorithms to evaluate search time and memory requirements

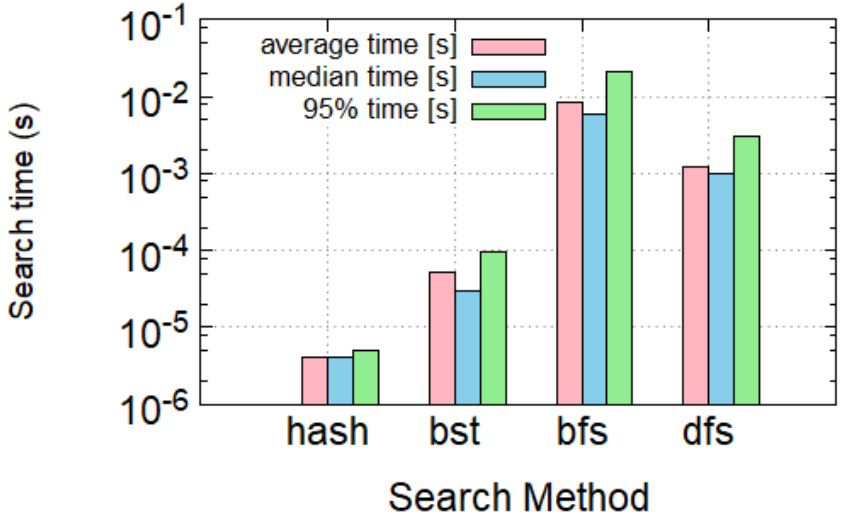
- Uniform random selection
  - Randomly selects one from existing unauthorized transactions
- Unweighted random selection
  - Equal probability selection of transactions referenced from initial transaction
- Weighted random selection
  - Selecting transactions referenced from initial transaction with consideration of cumulative weights

Required Search Time

Tip selection: uniform random selection



Number of transactions = 100

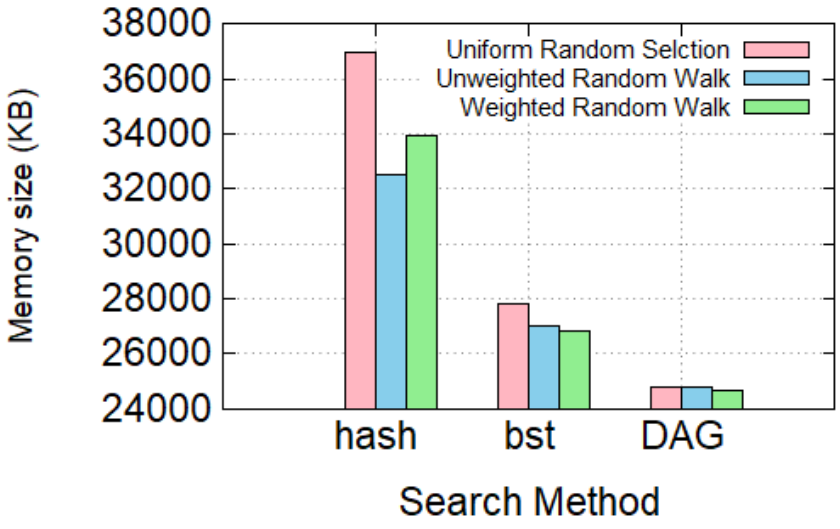


Number of transactions = 1000

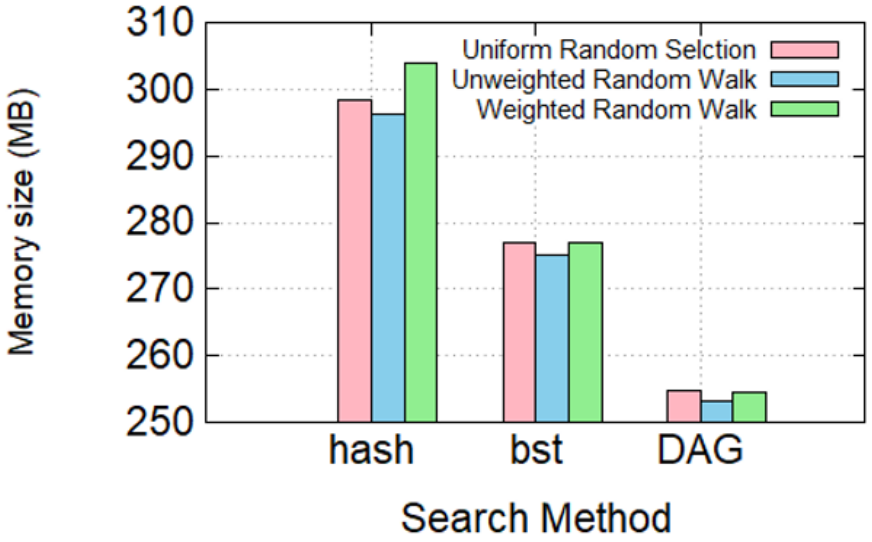
- Number of transaction = search time in 100 and 1000 (URW)
- Search time increases in the order of hash chain method, binary search tree, depth–first search, breadth–first search

Required Amount of Memory

Tip selection: uniform random selection



Number of transactions = 100



Number of transactions = 1000

- Hash chain method, binary search tree, and DAG reduce memory requirements in that order

- When search time is important. → hash method
- When emphasizing memory requirement → DAG

Conclusion

- Conclusion
  - Proposed micropayment system using IOTA
  - Without transaction fees
  - Compared search time and memory requirement among four search methods for searching content names in IOTA
- Future work
  - Evaluation using actual equipment

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