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Routing Table Construction Method Solely Based on **Query Flows** for Structured Overlays

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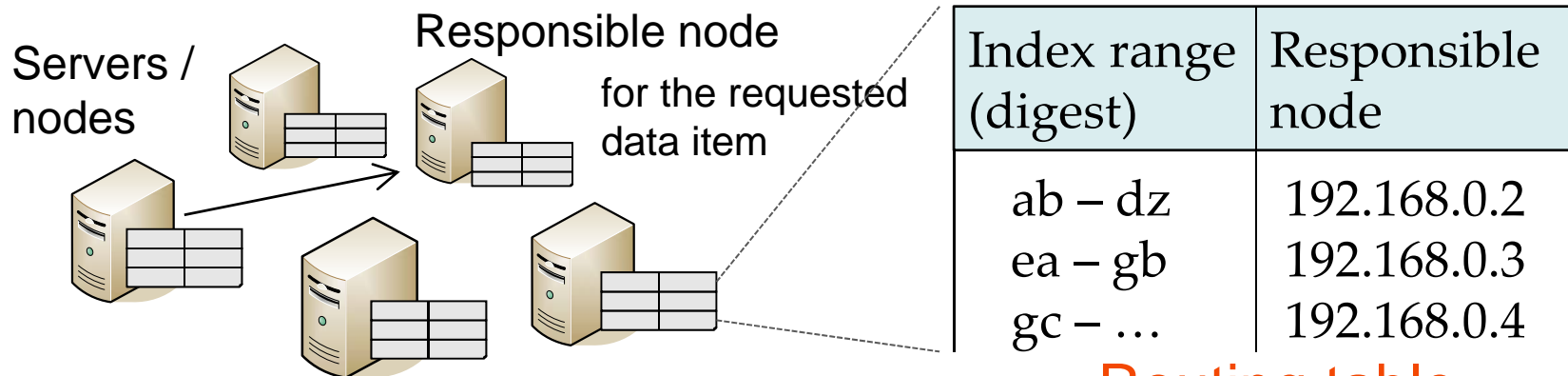
Tokyo Tech

*Overlay
Weaver*



Background: Structured Overlay

- An **application-level network**
 - **routes** a query to the responsible node.



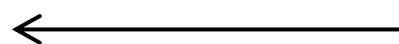
Routing table

- enables scalable **data store** and **messaging**.

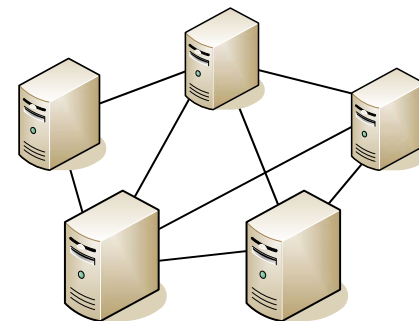
- e.g. Distributed Hash Tables (DHT)



“Shudo” ‘s tel # ?



“+81 3 5734 XXXX”



Contribution



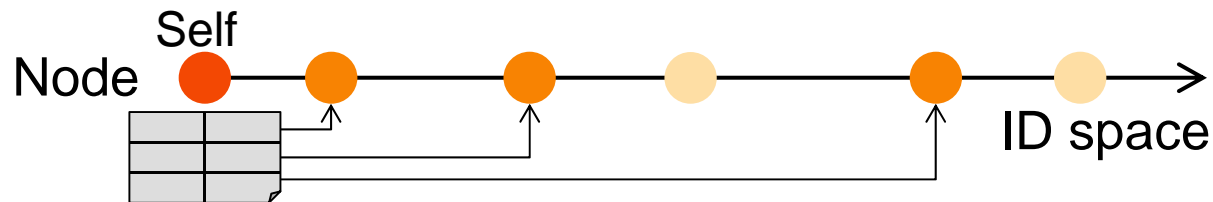
- Our finding:
 - Small number of hops **does not require node distance** in routing table construction and maintenance.
 - E.g. Chord based on node ID difference and Chord# based on number of nodes between nodes achieve $O(\log N)$ hops.
- Evidence:
 - Flow-based FRT (**FFRT**):
A routing table construction method
 - **FFRT-Chord**: An FFRT-based structured overlay

Node distance based routing table construction

- Each node determines which other nodes to be on its routing table based on

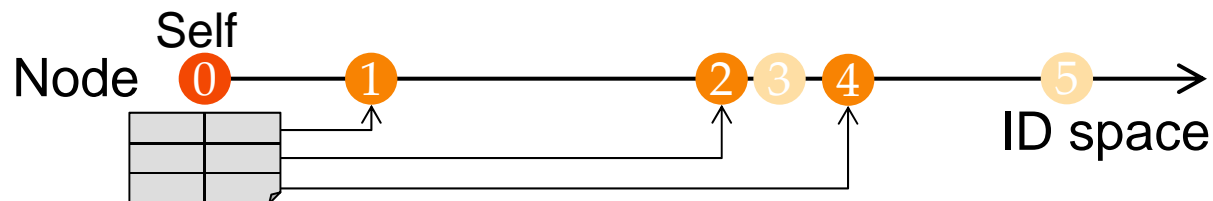
- **ID difference**

- in Chord, Kademlia, ...
- Responsible nodes for self ID + 1, 2, 4, ..., 2^i



- **Number of nodes between the two nodes**

- in Chord#
- 1, 2, 4, ... 2^i nodes away from self



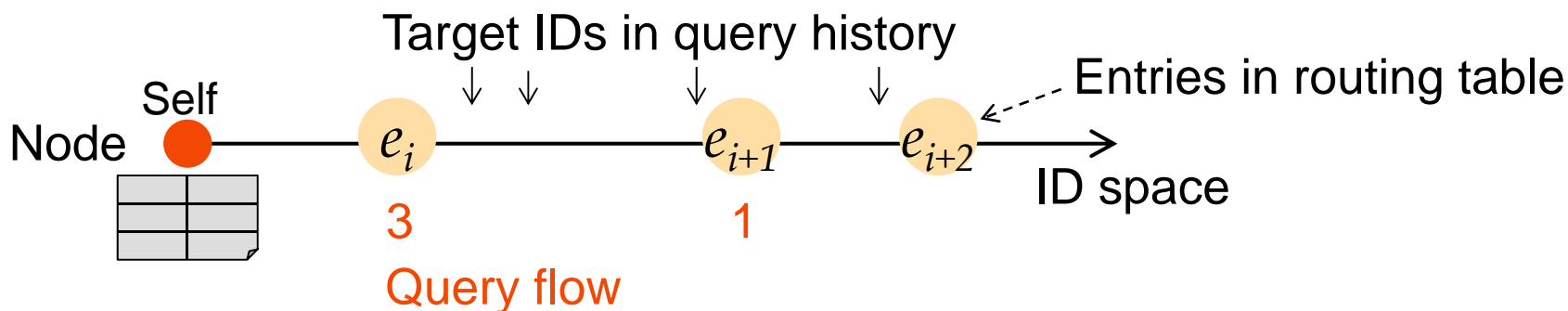
Flow-based FRT (FFRT)

- A routing table maintenance method
 - Not node distance based
 - Instead, **query flow** based
- An application of Flexible Routing Tables (FRT) [P2P'11]
 - A routing table is just a list of nodes.
 - A policy given by an algorithm designer \leq_{ID} determines which nodes to be kept on a table.
 - FFRT specifies a policy based on query flows: \leq_{FL}

Query flow

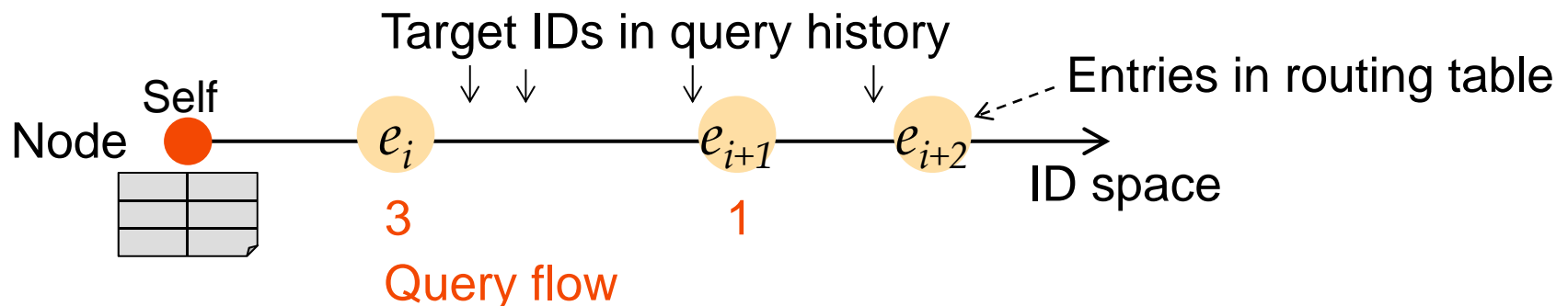
- Query flow

- A node keeps query history: target IDs of the recent H queries including queries it forwards.
- Query flow for an entry in a routing table is the number of queries in the query history to be forwarded to the entry.



Query flow based routing table maintenance

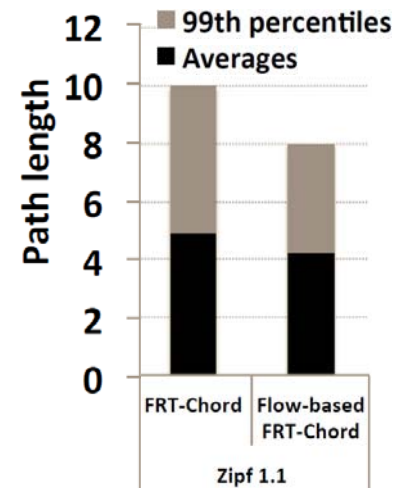
- A node refines its routing table to minimize the variance of query flows of all the entries.
 - In other words, towards a state in which all nodes on the table have equal query flows.
 - When *Entry Filtering* of FRT, A node selects a removed node to minimize ...
 - \leq_{FL} : Routing tables with smaller variance precede.



Experiments

Overlay Weaver

- Confirmed that an FFRT-based overlay achieves **comparable hop counts with existing overlays**.
 - It works well with nonuniform ID distributions because its routing maintenance is not based on IDs, though comparison with overlays for nonuniform ID distributions such as Chord# is part of future work.
- FFRT-Chord implemented on Overlay Weaver [ComCom 2008] and compared with FRT-Chord.
 - FRT-Chord shows smaller hop counts than Chord with moderate routing table sizes, 20 or larger.



Summary and future work

- In structured overlays, small number of hops such as $O(\log N)$ **does not require node distance** in routing table construction and maintenance.
 - **Query flow** based method, **FFRT** and FFRT-Chord presented as an evidence.
- Future work
 - Theoretical analysis and reasoning.
 - With weighted graph, or so?