

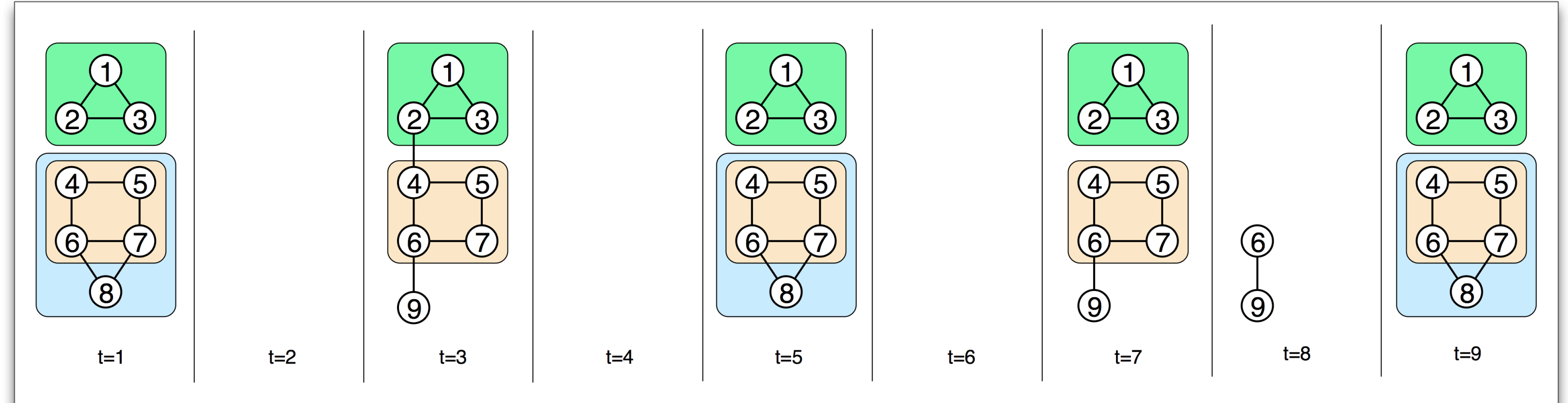
1. Introduction

- Regular temporal patterns in the interactions among groups of agents can be observed in real-world systems.
- Many **networks of colocation** exhibit this property.
- Examples include wildlife monitoring networks, pocket-switched networks, and vehicular networks.
- Identifying **communities of individuals** that **regularly meet** has applications in areas such as opportunistic unicast delivery, content sharing, and trust.
- In the absence of knowledge of the whole network, a **decentralised solution** is required to allow individuals to identify their periodic communities.



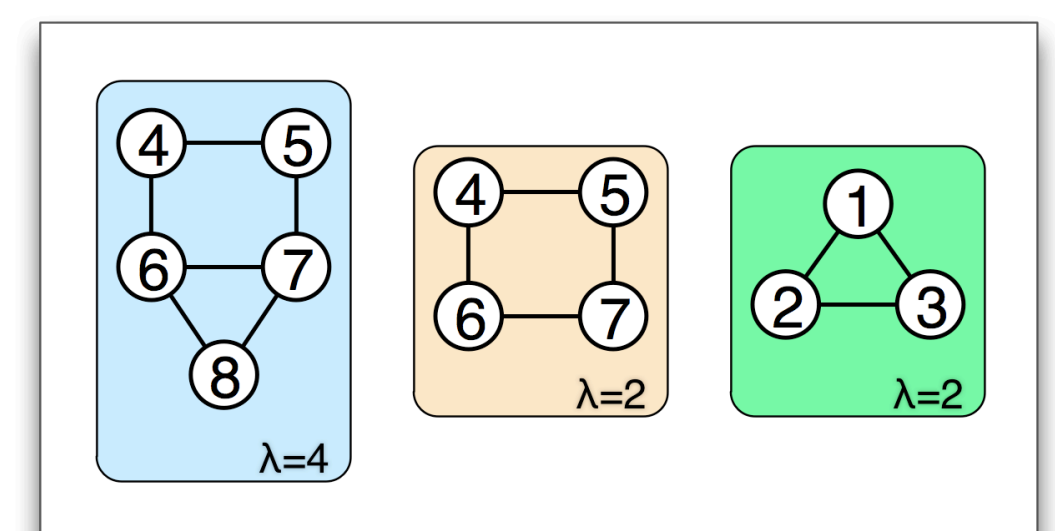
2. Periodic Encounter Communities

- A **dynamic encounter network** (DEN) is a time series of encounter graphs.
- Each **encounter graph** represents the encounters occurring during a particular time step.



Example dynamic encounter network

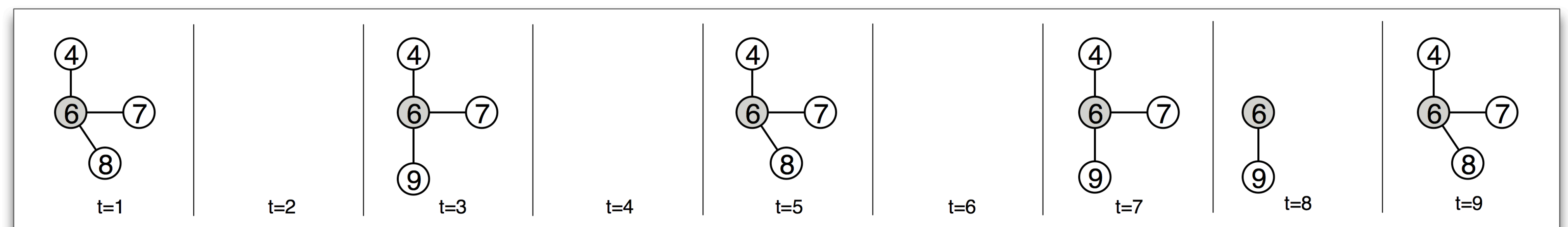
- A **periodic encounter community** (PEC) is a connected subgraph that re-appears in a DEN with a fixed period.



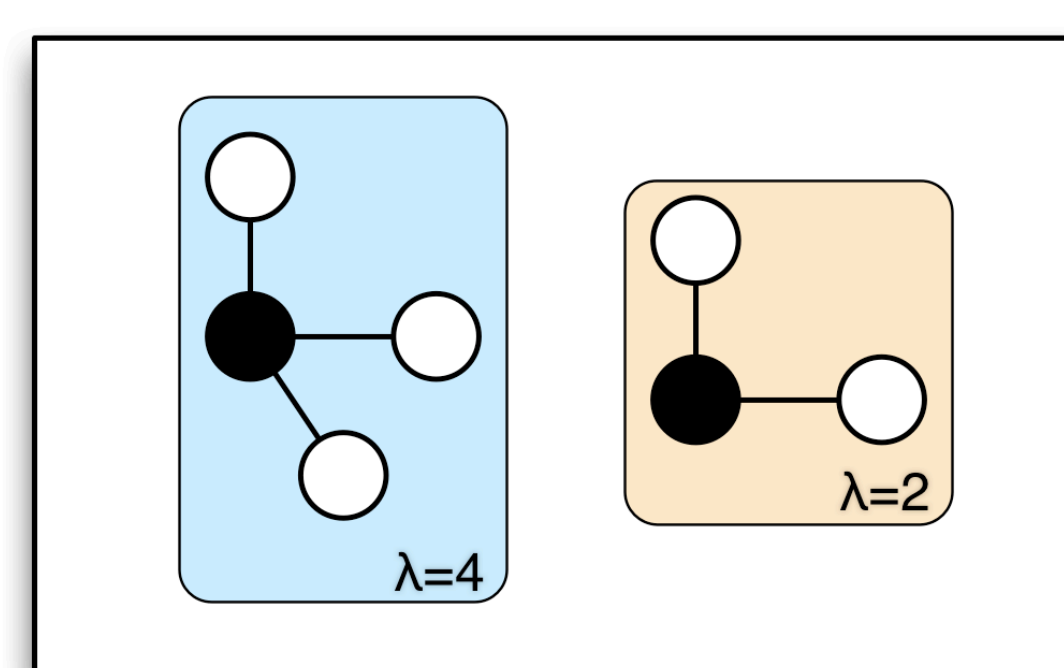
Maximal PECs with support > 2

3. Decentralised PEC Detection

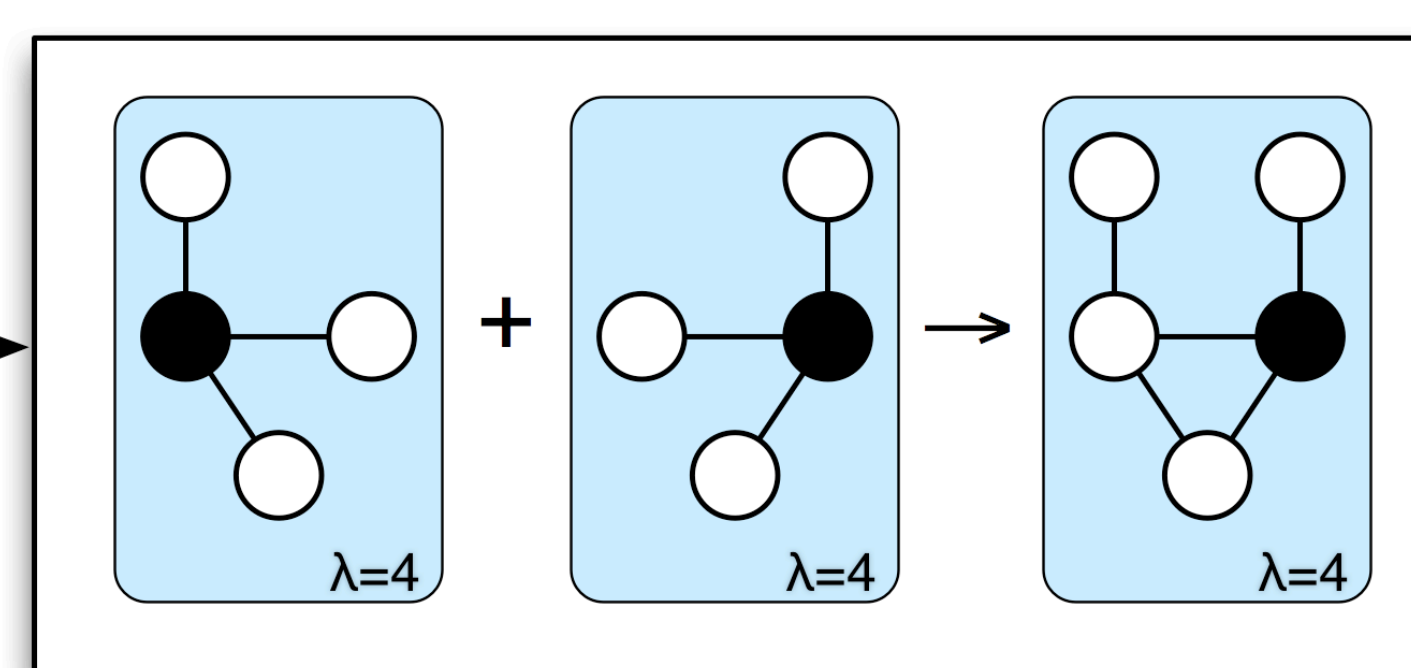
- The objective is for each node to discover all the PECs it belongs to.
- Discovered PECs should be **harmonically, structurally, and temporally maximal**.
- Nodes have available only knowledge of their local encounters. We refer to a node's local DEN as its **intrinsic DEN**.
- Periodic subgraph mining** extracts locally-maximal PECs from the node's intrinsic DEN.
- From **local mining** and **local PEC sharing**, globally-maximal PECs are obtained.



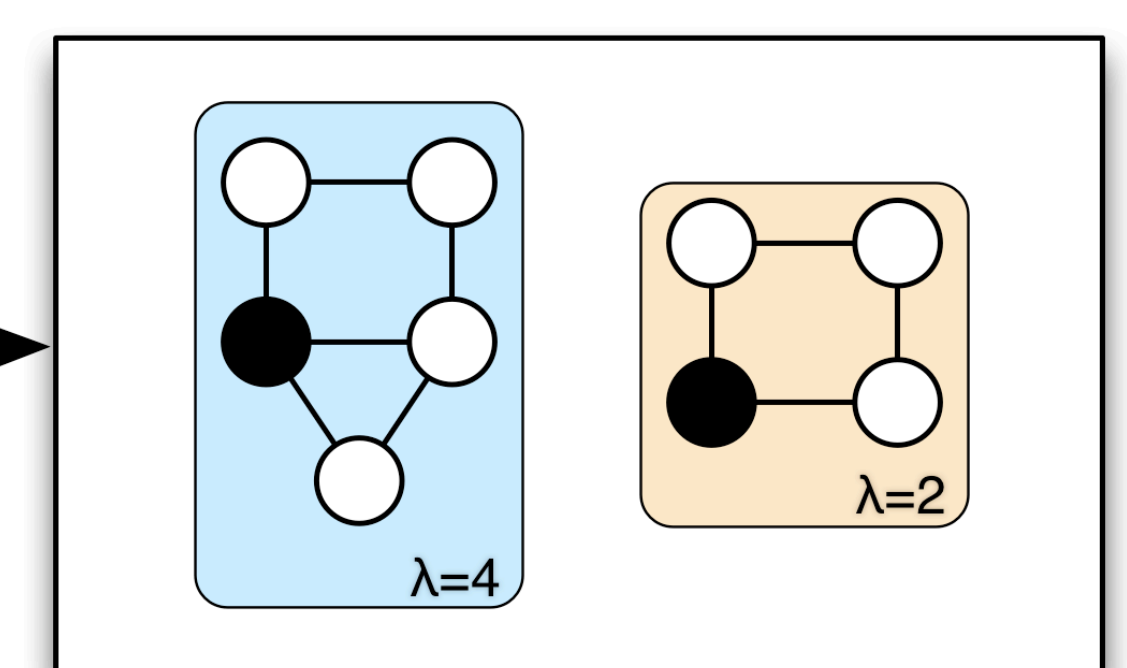
Intrinsic dynamic encounter graph of node 6



Local PEC mining



Local PEC sharing and merging



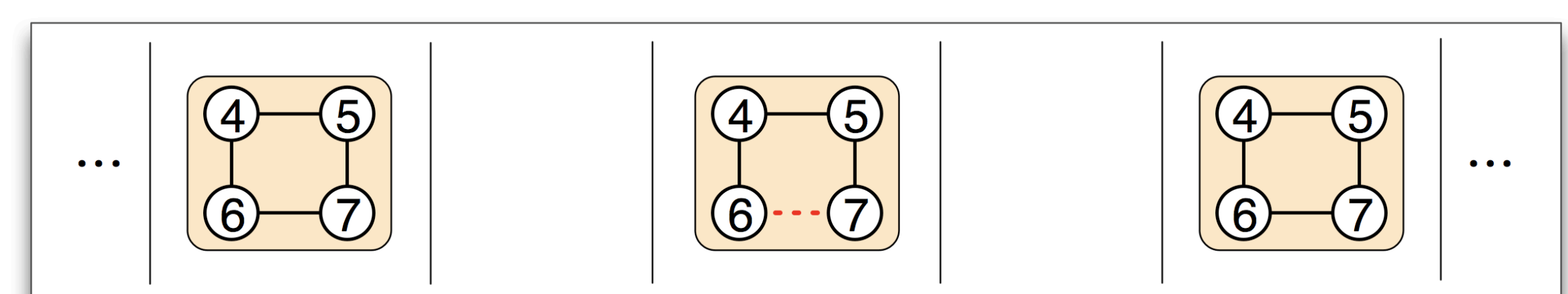
Globally-maximal PECs

4. Evaluation

- We have formally shown that the decentralised algorithm obtains globally-maximal PECs.
- We have also developed a **DEN generator** to simulate node connectivity over time.
- The DEN generator produces repeating communities with specific characteristics: size, period, clustering, density.
- Real colocation data sets (e.g. bluetooth sightings, access point connections) offer opportunities to test the algorithm in realistic scenarios.

5. Future Work

- Future work will adapt PEC detection to handle the more challenging features of PECs:
- Fuzziness:** In real networks uncertainty is expected. Very rarely will communities have perfect periodicity. Detection must allow for occasionally absent edges.



- Transience:** A PEC may only exist for a finite duration. Previously detected PECs may disappear and new PECs may emerge.
- Other analysis will consider:
 - The effect of PECs on content dissemination.
 - Bounds on the time for PECs to achieve global maximality.
 - The effect of granularity choice on the DEN and PECs.