

A survey on clustering in VANETs

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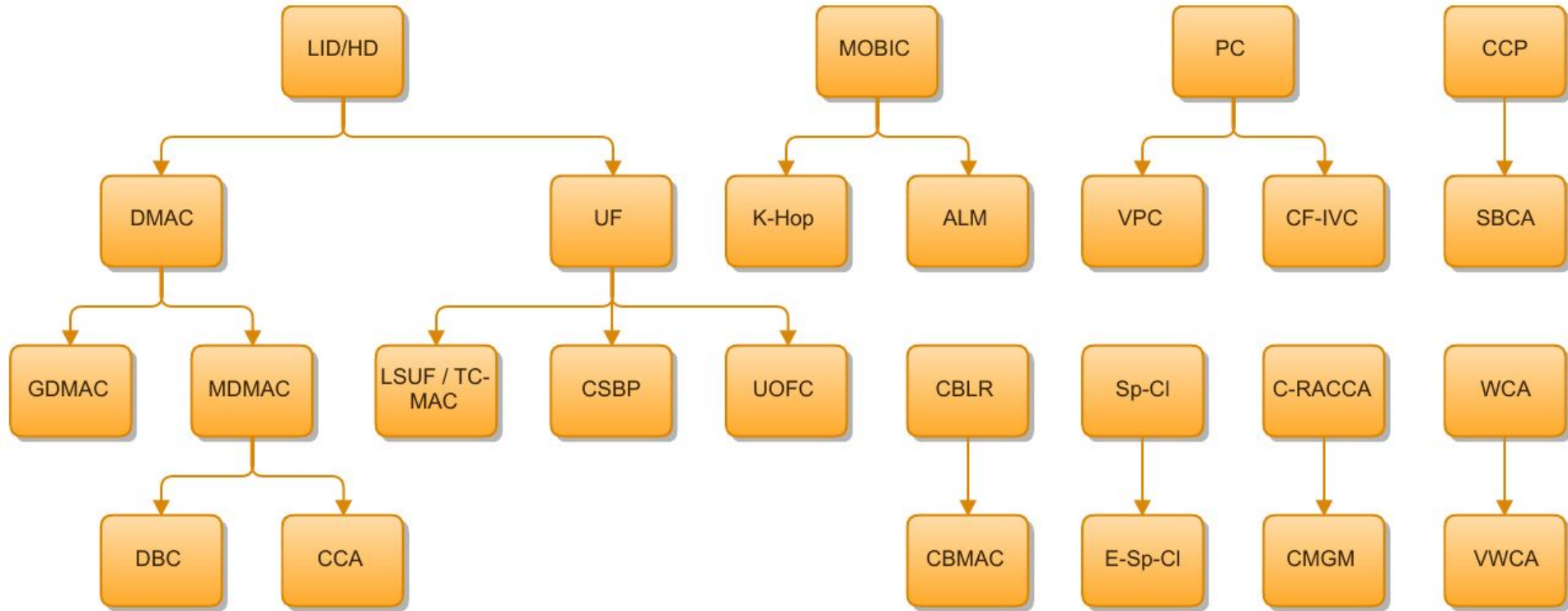
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Goal

Clustering can be used to strategically partition the network into smaller segments. This has many benefits:

- Improve routing scalability & reliability
- Optimising bandwidth usage
- Information dissemination
- Distribution of resources

VANET clustering algorithms



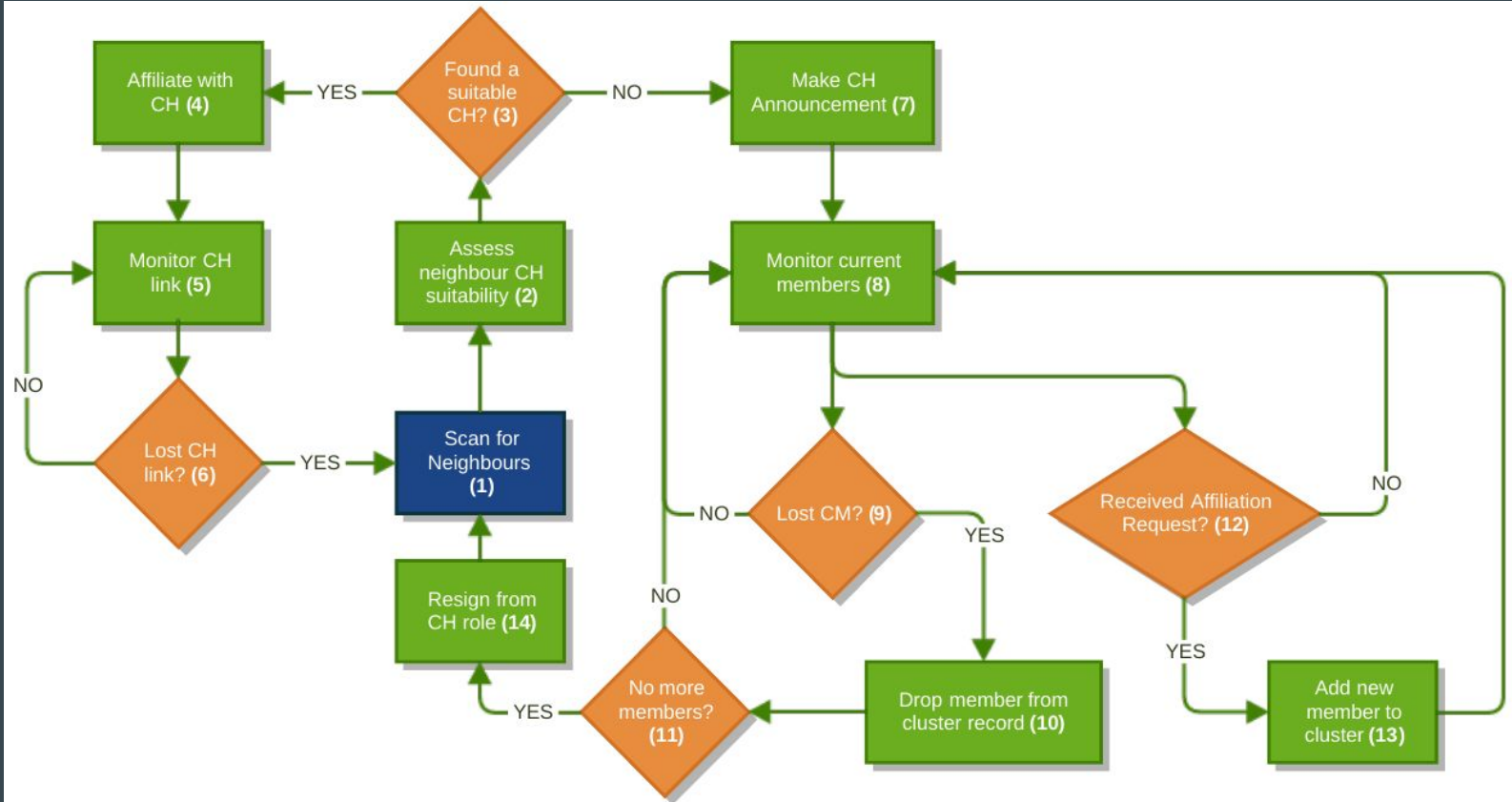
Different problems compared to MANET

Many clustering algorithms exist that work well in MANETs but which perform poorly in VANETs due to specific characteristics:

- Rather than moving random, vehicles tend to move in organized fashion.
- Most vehicles are restricted in their range of motion
- Usually higher velocity and more difference in relative speed
- May be within range but unable to comm. due to building, large vehicle etc.
- Vehicular behaviour / driver intention

Most research focus on cluster stability which is strictly related to CH selection and maintenance!

How does it work?



What's the difference?

Almost every one of VANET clustering algorithms use the same flow yet they differ in these three specific problems:

1. Cluster head selection
2. Affiliation
3. Maintenance

CH selection strategies

- Weighted network metrics
 - Most common approach
 - Nodes advertise their own fitness to be a cluster head
 - Weighted sum of various metrics such as uptime, distance, vehicle class, relative velocity, node degree etc.
- Precedence
 - Also use weighted metrics but, unlike the previous approach, a node looking for a CH will make its own decision of the CH selection
 - Nodes seeking CH can act selfishly. May result in larger number of CH.
- Timer
 - Wait for a period of time looking for a CH, if detected, affiliate with it. Otherwise announce yourself a CH
 - Hidden node problem - Multiple nodes may announce themselves CH,

CM affiliation strategies

- Regular affiliation
 - Join request received from candidate member node, if accepted, CH insert its members table
- Affiliation with handshaking
 - Use handshaking to decide whether or not to accept a node to be CM.
 - Limit the number of CM a cluster can have
 - May help prevent faulty affiliation
 - Increased overhead

Cluster maintenance strategies

- CM updates
 - Hello messages sent by all nodes for neighbour discovery
 - or CH polls the cluster periodically and members respond with a unicast message
 - CH may drop non-responding CMs or vice versa - may caused by collisions or transmission errors
- CH depreciation
 - CH may become sub-optimal for its role - Disbands the cluster in a controlled manner
- Cluster merging
 - Hierarchical approaches try to merge smaller clusters to larger clusters
 - Some employs techniques to prevent unnecessary merging such as CH metric comparison with a set of threshold, link expiration time or difference in group velocities

Comments so far...

- Still developing area which has fundamental shortcomings that needs to be addressed in order to be practically used.
 - Most of them are based on clustering methods previously proposed for MANET
 - Need to use VANET-specific metrics more often (e.g. driver intention detected by indicator signals or accelerometers, taking number of lanes into account during CH selection,)
 - Comm. modelling which properly reflect the real world as much as possible
 - Specific applications need specific solutions
 - Need for widely-accepted metrics & validation methods

References

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