

Local Peer Group Architecture and Organization for Vehicle Communications

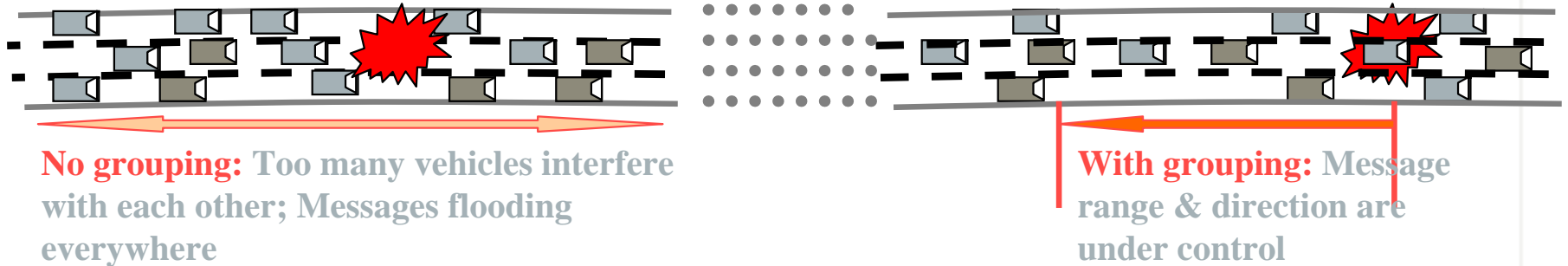
By
Wai Chen
Jasmine Chennikara-Varghese
Shengwei Cai

V2VCOM 2005 Workshop
July 21, 2005

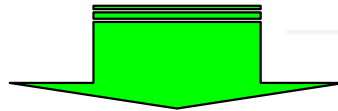
Outline

- Need for Manageable Units for Vehicle Communications
- Two Local Peer Group Architecture Alternatives
- Group-header based LPG Organization
- Summary

Grouping Is Key for Vehicle Communications



Without boundaries, (1) too many vehicles interfere each other, (2) all messages may propagate everywhere => Poor and unreliable communications.

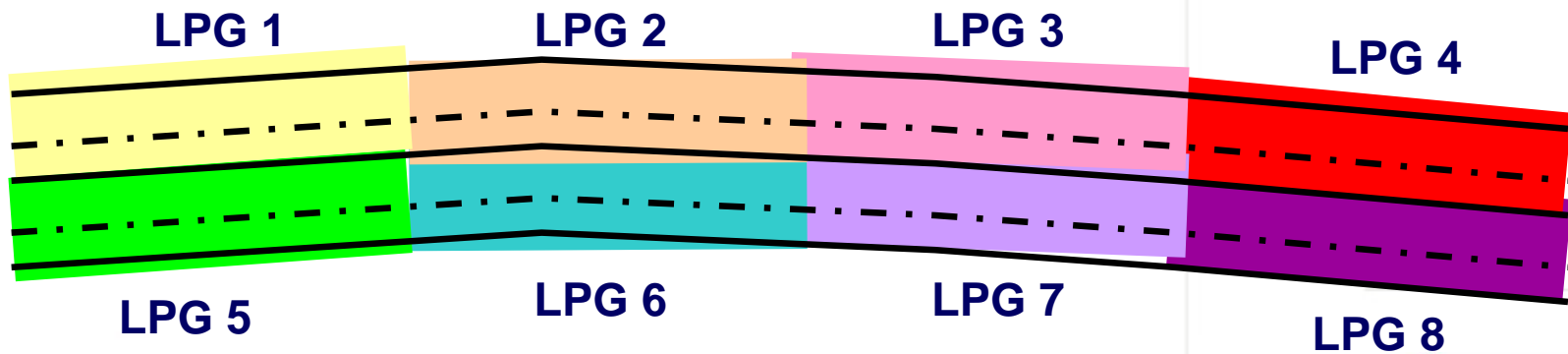


- We need to maintain *manageable vehicle groups* for safety applications.
- We need to deliver relevant emergency message very quickly and efficiently in such vehicle group and stop message at group boundary. (*Intra-group communication*)
- When necessary, pass the message to neighbor groups through the group boundary vehicles. (*Inter-group communication*)

Stationary LPG Organization

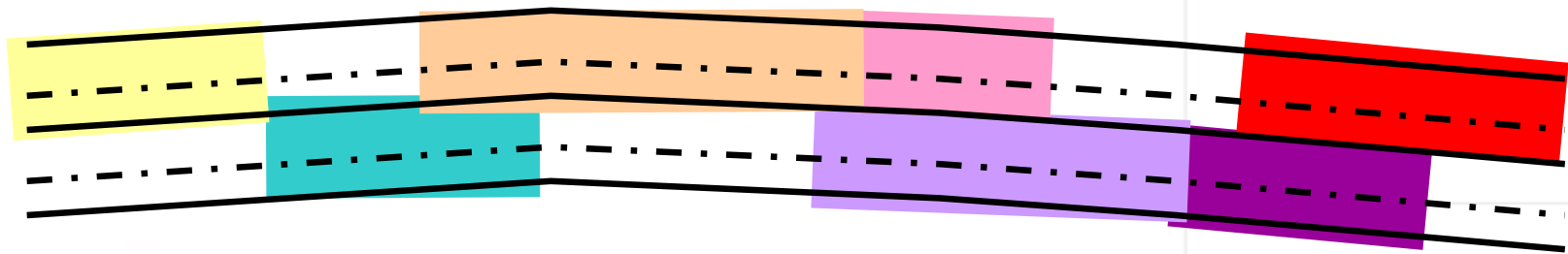
Zip Code Areas Approach

- Basic Architecture Features
 - Use GPS-based grid to partition roadways into “zip code areas” that define LPG: if you’re in area 1, you belong to LPG 1, ...
 - Assume GPS reception everywhere
 - May work with navigation systems to define the LPG
 - Independent of radio coverage among the vehicles within the same LPG
 - Vehicles keep changing its LPG when traveling



Dynamic LPG Organization

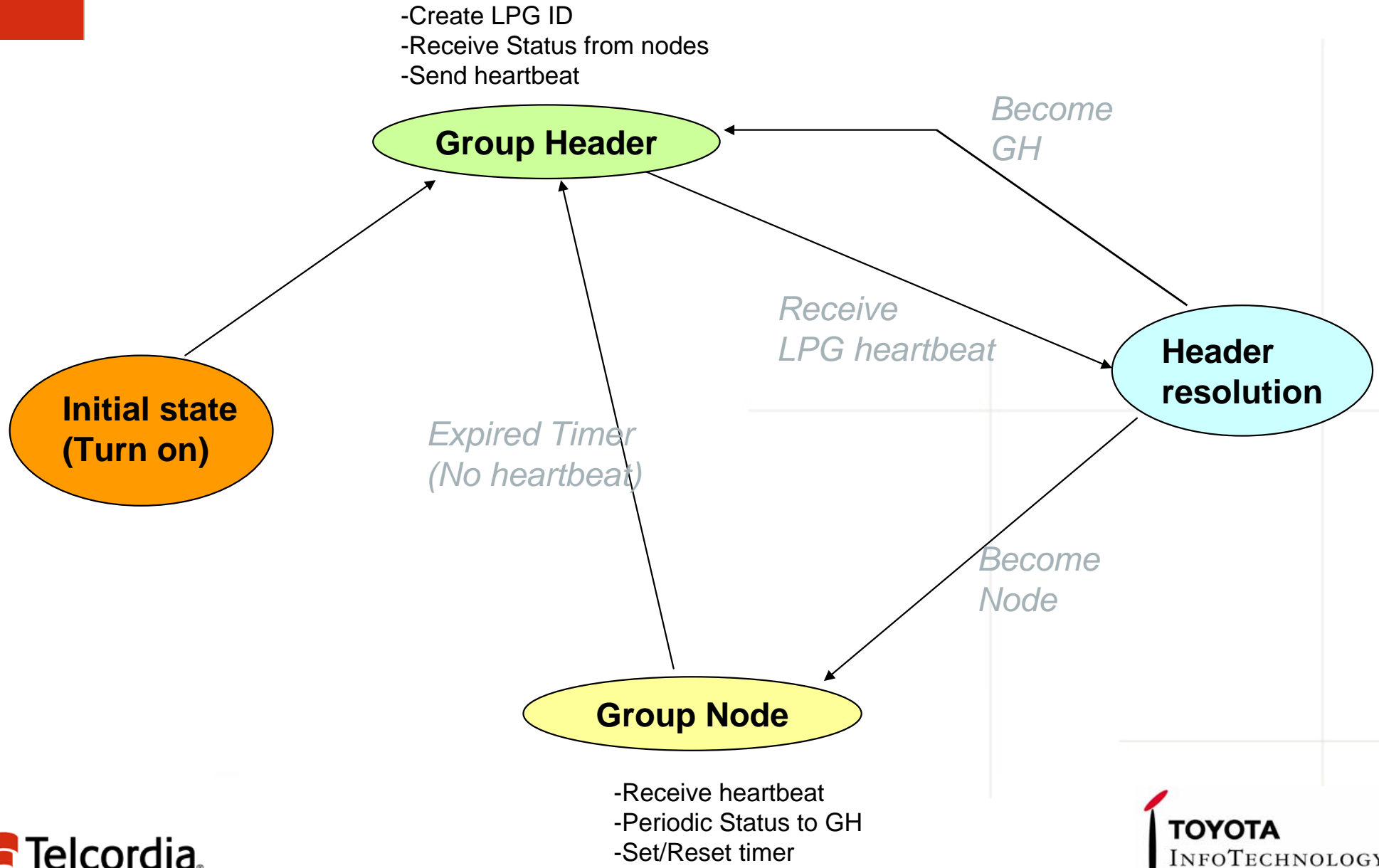
- Organize neighboring vehicles into dynamic LPGs based on
 - Radio coverage – vehicles within coverage organize into LPG
 - Unlike the zip code approach, vehicles in a LPG can always communicate with each other.
 - LPG can adapt to remain reasonable size (e.g., number of vehicles)
 - Within each LPG, one-hop and multi-hop communication should be supported
 - Unlike the zip code approach, vehicles don't need to change their group association as long as they remain in the same LPG.



Group-Header based LPG Organization

- LPG Identity:
 - Created by the group header (GH) within LPG
 - LPG is identified by an LPG ID plus the GH ID
- Group Header (GH)
 - This node creates and maintains identity for LPG
 - GH handles changes in LPG membership
- Group Node
 - Node in LPG which is not a group header
 - Periodically sends status to GH to continue being part of the LPG
 - Can become a GH if current GH disappears

GH-based LPG State Machine



Summary

- Stringent performance requirements and dynamic roadway environment pose new networking challenges.
- Proposed two LPG approaches to organize neighboring vehicles:
 - Stationary LPG
 - Dynamic LPG
- Proposed GH-based scheme to form and update LPG
 - Scheme has been verified by simulation, but
 - Future work to
 - Characterize detailed dynamic LPG performance