

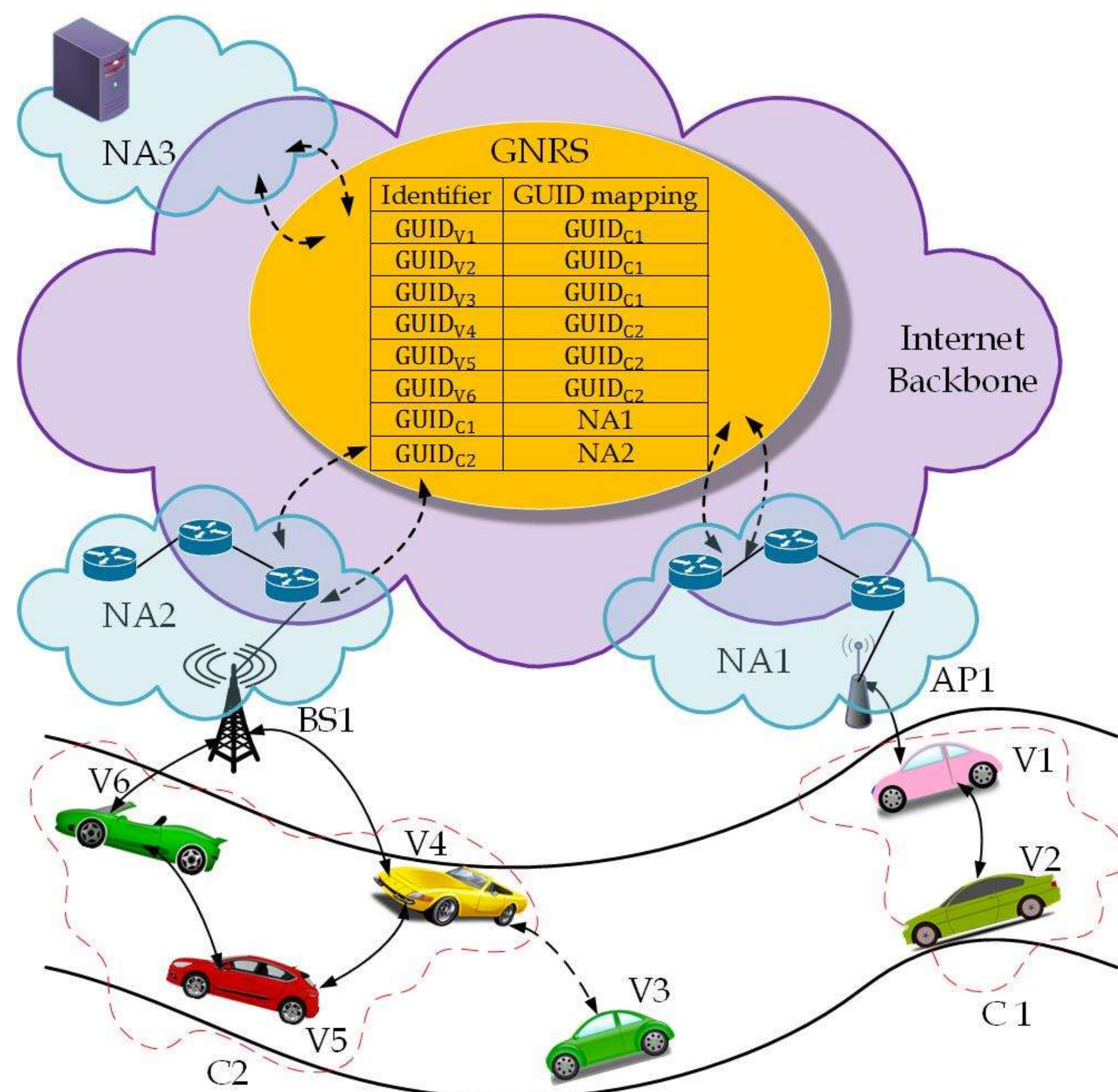
MobilityFirst Features

- Clean separation of names and network addresses using GNRS
- Communication using location-independent and self-certifying IDs (GUIDs)
- Ability to communicate with endpoint principals identified by attribute-based descriptions (e.g., *send(message, "Taxis near TimesSquare")*)
- Existence of Multicast GUID to communicate with a group of network principals
- Storage-aware intra-domain routing protocols
- Seamless support for end-host multi-homing
- Delay & disconnection tolerant store-and-forward routing (GSTAR)

Objectives

- Design protocols to enable opportunistic networking for highly mobile nodes with intermittent connectivity
- Form stable network clusters among nodes with similar mobility
- Extend Internet connectivity through networked clusters, enabling data offloading from cellular to WiFi
- Local P2P content exchange in isolated clusters
- **Challenges:** vehicular speed variations over time, short-lived links, intermittent connectivity, fluctuations in network load due to variable node density and data traffic demands, lack of central coordination, network discovery overhead

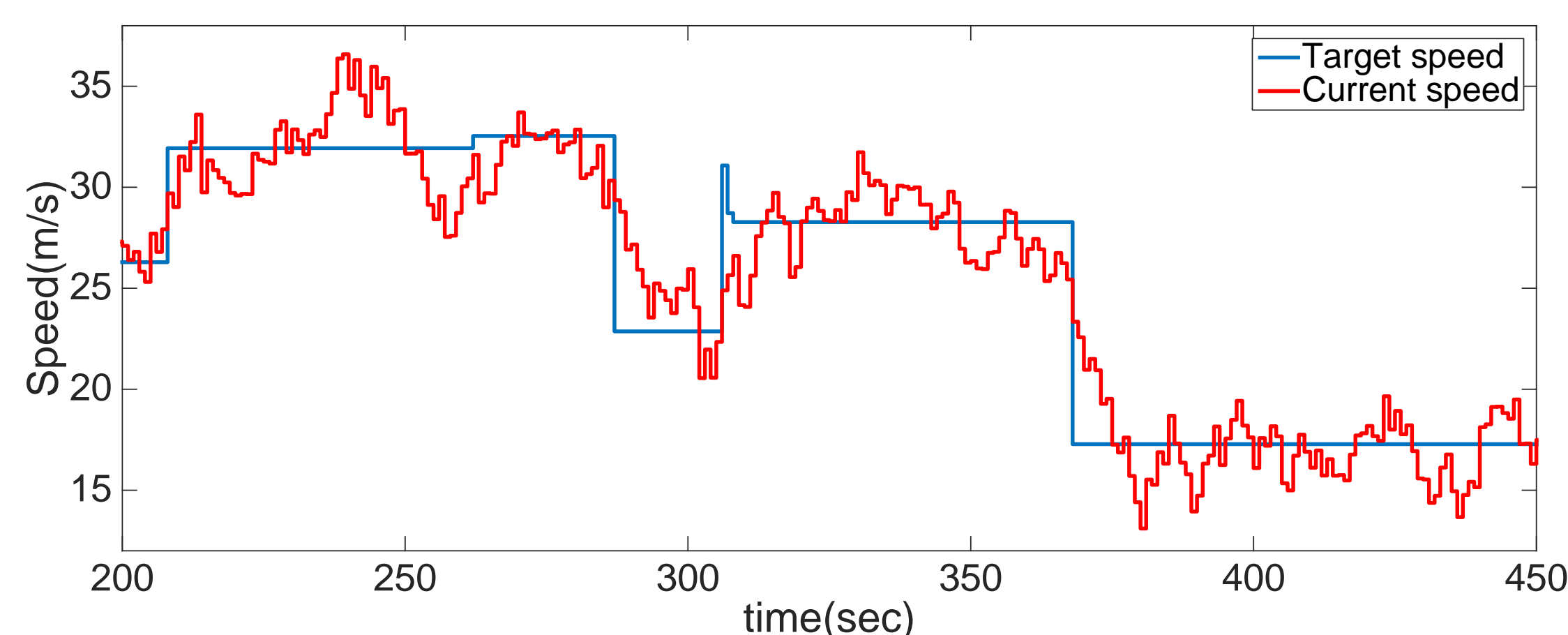
System Model



Gauss-Markov Mobility Model

$$v_{j+1} = Zv_j + (1 - Z)v_a + S\sqrt{1 - Z^2}Z_j$$

New speed Current speed Target speed Speed noise



VANET Discovery Protocol

1. Hello Message Exchanges

- To identify neighbors, nodes periodically broadcast HELLO messages containing

Node GUID	Cluster GUID	Target Velocity	Current Velocity	ζ
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2. Link Stability Assessment based on Hello Message Mobility Parameters

- To exclude short-lived unstable links from clusters
- To consider all modes of link disconnection
 - A probabilistic approach
 - Minimum target link lifetime: τ
 - Mobility parameters: $\Delta v_a, \Delta v_j, \zeta$
 - A link is accepted if $P[\text{Link lifetime} \geq \tau | \text{Mobility Parameters}] \geq \beta$

3. Periodic state vector exchange over stable links

- To make bilateral clustering decisions
 - Shortest path to access point (AP)
 - ETT (expected transmission time) path metric which depends on bandwidth & packet losses
- To enable shortest path routing within clusters
- To update the GNRS

Node GUID	Cluster GUID	ETT to closest AP
Member list	Cluster/link state info TBD	

Work in Progress

- Optimization of 3-stage network discovery
 - Link stability assessment
 - State vector design
- Multi-homed Clustering
- Evaluate application-layer ad hoc network performance

Results

Number of access points	12
Number of vehicles	200
Path	12 km circular highway

