A Semantics-based Multi-agent Framework for Vehicular Social Network Development

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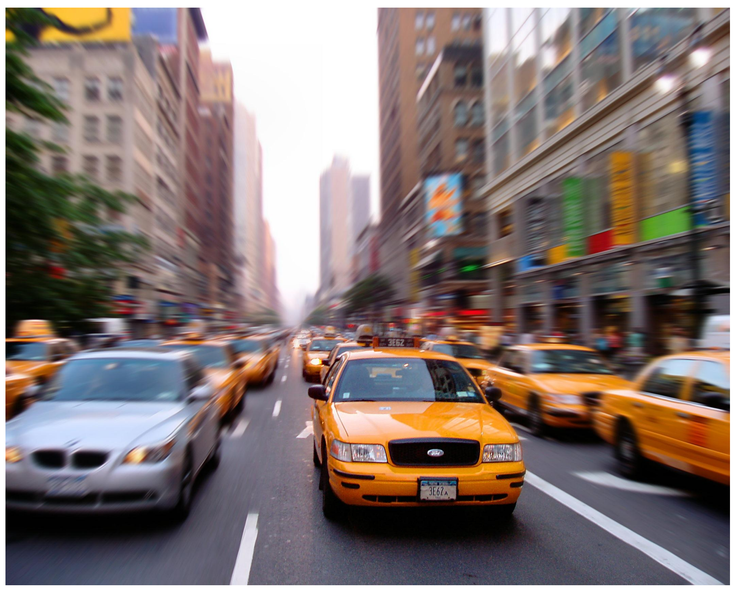
Development of Applications for Vehicular Social Networks



Applications potentially supported by vehicular social networks:

- Safety improvements − applications that improve the safety of drivers and passengers on the roads.
- Traffic management − applications enabling improvements of traffic efficiency and driving behavior.
- Infotainment − applications that enable content providers to share multimedia files with occupants of vehicles, and vehicular occupants to share multimedia files with each other.

Current State of Application Development for Vehicular Social Networks

Two main challenges of applications in VANETs: **mobility management** and **coordination**.

Current approaches to application development for vehicular social networks:

Middleware approach: Tightly coupled with applications.

Language approach: Do not provide implemented application services, low developing efficiency.

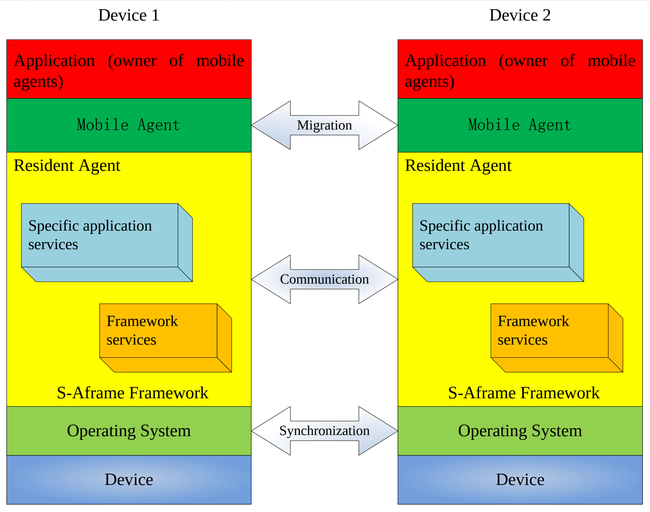
Three main goals of proposed framework for development of vehicular social network applications:

- Supporting high-level application programming.
- Providing a systematic approach.
- Supporting easy and effective programming.

Proposed approach: S-Aframe

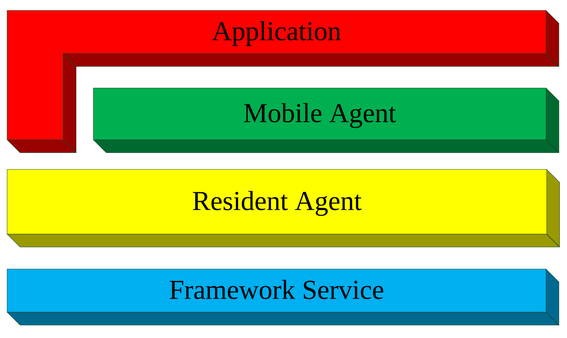
- Integrating advantages of middleware approach, language approach, software agent and semantic techniques.
- Developing a multi-layers framework to support application development for vehicular social networks.

Overview of S-Aframe Framework



The S-Aframe model

In S-Aframe, application developers can invoke, configure and extend services of resident agents to provide all the application services on nodes of VANET.



Architecture of S-Aframe

Mobile agents can automatically migrate around VANET and dynamically use different application services with their state and execution results

An application creates and sends mobile agents to travel in an underlying VANET and retrieve them back to the application's device.

Application layer

Owner of mobile agents. Provides interface to mobile device users. S-Aframe supports multiple agents from multiple applications in multiple devices working at the same time.

Mobile agent layer

Mainly used to execute different application services provided by resident agents. Does not contain application services in its code.

Resident agent layer

Provides all the local application services to visiting mobile agents. Two types of services in this layer: Framework services and Specific application services.

Framework service layer

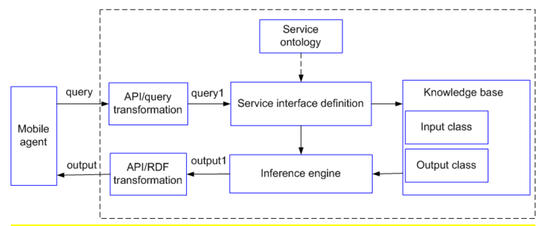
Provides the core functions and services to the upper layer and helps agents self-adapt to VANET.

Semantic Services in S-Freame

Service Ontology: Defines attributes and properties of services (resources, operations, inputs, outputs, etc). Each service can be regarded as an instantiation of the service ontology.

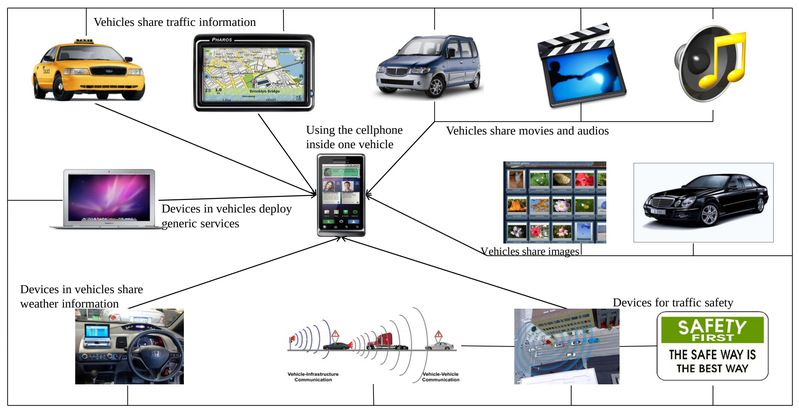
System Architecture of Semantic Services: Mobile agents pose queries which are then transformed to semantic queries based on the service interface definition, and interact with services in knowledge base.

The inference engine executes reasoning procedures with semantic queries over the knowledge base and returns input and/or output information of services.

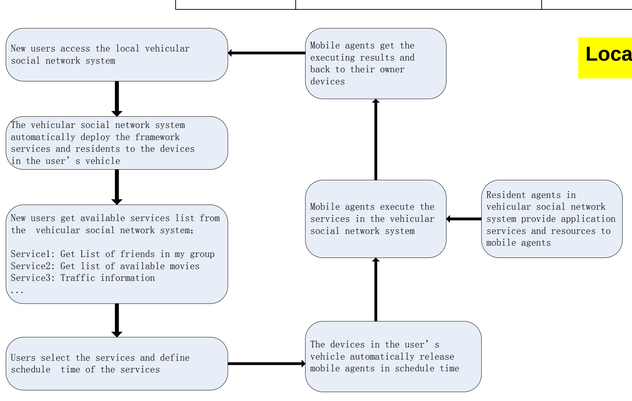


System Architecture of Semantic Services

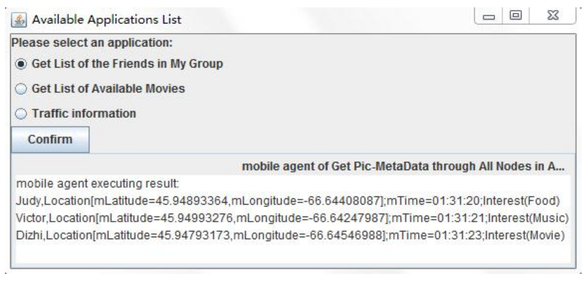
Application Example



Local vehicular social network system



The working procedure of vehicular social network system with S-Aframe



Users' information collected by mobile agent

Common picture for users displayed by application

Comparison and Evaluation

Project	Programming model	Systematic approach	Effectiveness
AmbientTalk	Actor	Partial support	Low
MobiSN	None	Partial support	Low
RoadSpeak	None	Partial support	Middle
S-Aframe	Multi-layer	Support	High

MobiSN: It provides core implemented functions and services for a mobile ad-hoc social network. However, it does not provide the extensibility support to developers, thus it is difficult for it to provide sufficient applications to users of vehicular social network systems.

RoadkSpeak: It just provides voice chat service, but does not provide other services, thus it can hardly fulfill the diverse service requirements of users in the vehicular social network systems.

AmbientTalk: It can incorporate network failures in its programming model, and it employs a purely event-driven concurrency framework based on actors. But it is a new language, and does not provide implemented application services, so the developing efficiency is low.

S-Aframe: it makes use of the mechanism of AmbientTalk symbiotic programming with Java, and integrates generic services in its framework, thus S-Aframe supports programmers easily and effectively develop applications for vehicular social network systems by using Java.