Intelligent Transportation Systems: Application, Challenges and Perspectives

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Data Analysis and GIS for Impact, Economics and Business (DAGEIB) Laboratory

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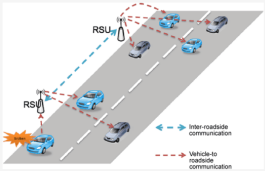
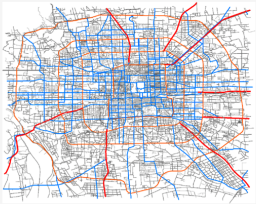
Road-map Review

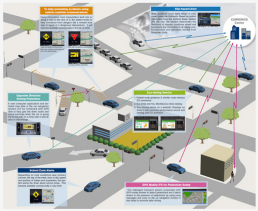
Section 0

Road-map

We believe in our research we will have to go through three different stages of studies:







1. Data Acquisition and Management in Vehicular Ad-Hoc Networks (VANs)
2. Diagnosis of the Road Network Characteristics using GIS and Geomatics disciplines
3. Data Analysis and Decision-Making

Section 1

Vehicular Ad Hoc Networks

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Vehicular Ad Hoc Networks

- What is VANET?
- Characteristics of VANETs
- Challenges of VANETs
- Data Collection in VANETs
- VANET Architecture
- VANET Simulators

What is VANET?

Vehicular Ad hoc Network (VANET) is a promising module of ITS. It's an emerging sub-class of Mobile Ad hoc Network (MANET) where vehicles act as mobile nodes. [GZ11]

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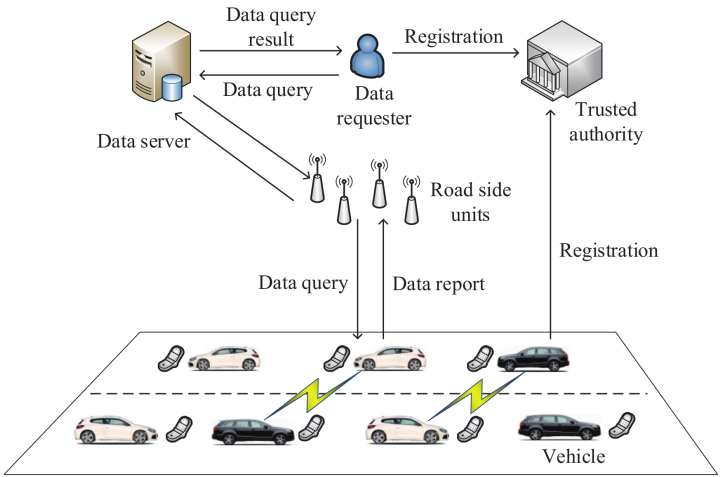

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- hard delay constraints. [PN19]

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- amount of data to be transmitted by the vehicle could be huge; data collection method should consider the network communication **overhead**.

Data Collection in VANETs

An efficient method for data collection must consider different parameters: data aggregation, latency, packet delivery ratio, packet loss, scalability, security, transmission overhead, and vehicle density as the performance parameters. [PN19]

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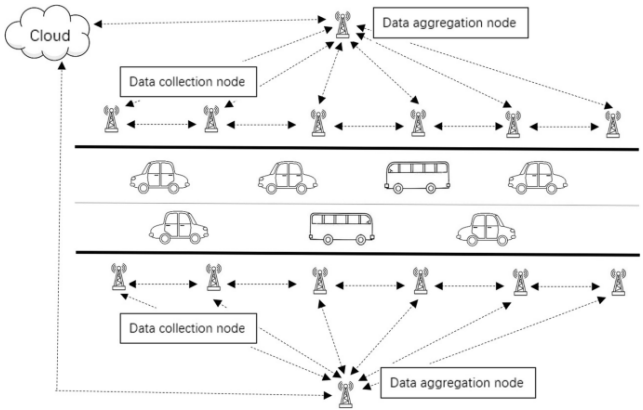

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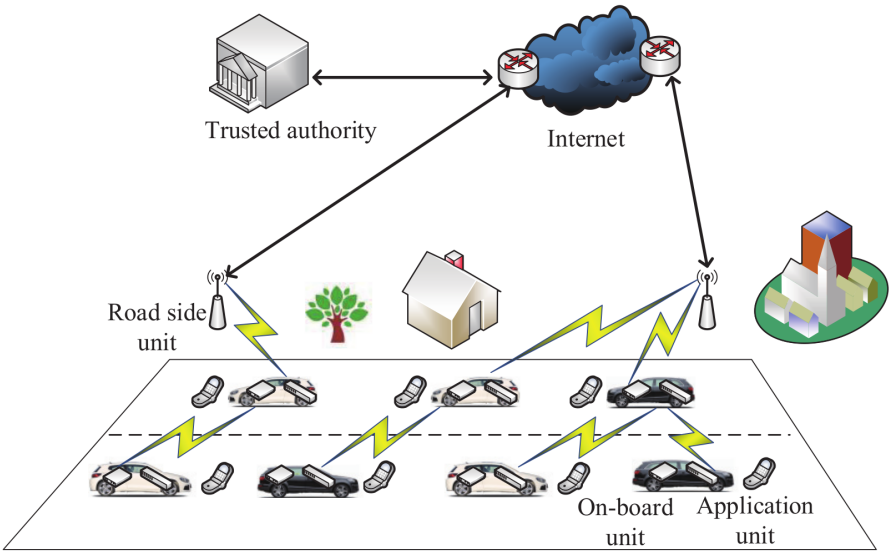

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Network Simulator	NCTUns [31]	2007
	ns-3 [14]	2008
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	GrooveNet [20]	2006
Mobility Generator	SUMO [4]	2006
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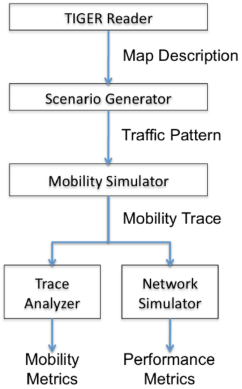

Section 2

Literature Review

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- VANET in ITS
- Big Data Analytics in ITS

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TABLE 9 An overview of the discussed data collection mechanisms and their comparison based on main metrics

Category	Author Name	Data Aggregation	Latency	Packet Delivery Ratio (PDR)	Packet Loss	Scalability	Security	Transmission Overhead	Vehicle Density
Topology-based	Pacheco-Paramo et al[84]	✗	✓	✓	✗	✓	✗	✓	✓
	Drira et al[81]	✓	✓	✗	✗	✗	✗	✓	✗
	Jiao et al[82]	✗	✗	✓	✓	✓	✓	✗	✓
	Qin et al[83]	✗	✓	✓	✓	✓	✗	✗	✓
	Turcanu et al[116]	✓	✓	✓	✗	✓	✗	✓	✓
	Malik and Pandey[80]	✗	✓	✓	✗	✗	✓	✗	✗
	He and Zhang[20]	✗	✓	✓	✗	✓	✗	✗	✓
Cluster-based	Liu et al[87]	✓	✗	✗	✗	✓	✓	✓	✓
	Bouali et al[86]	✗	✗	✗	✗	✓	✓	✗	✓
	d'Orey et al[85]	✗	✓	✗	✗	✓	✗	✓	✗
	Brik et al[11]	✓	✓	✗	✓	✓	✗	✓	✓
	Brik et al[64]	✓	✗	✓	✗	✓	✗	✓	✓
Geocast-based	Lee et al[88]	✗	✗	✓	✗	✗	✗	✓	✓
	Delot et al[89]	✗	✗	✓	✗	✓	✗	✗	✗
	Zarmehri and Aguiar[90]	✗	✓	✓	✗	✓	✗	✓	✓
Fog-based	Lai et al[91]	✗	✓	✗	✗	✓	✗	✓	✓
	Lai et al[92]	✗	✓	✗	✗	✓	✗	✓	✓

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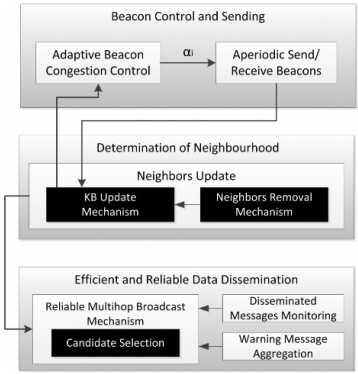

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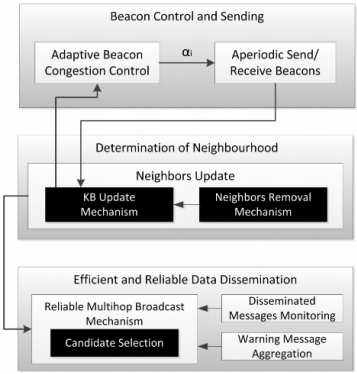

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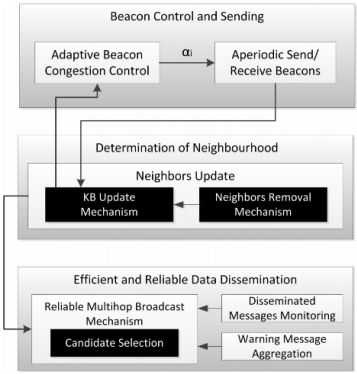
While also considering the delay sensitivity of safety message broadcasting; should be delivered in shortest time possible.



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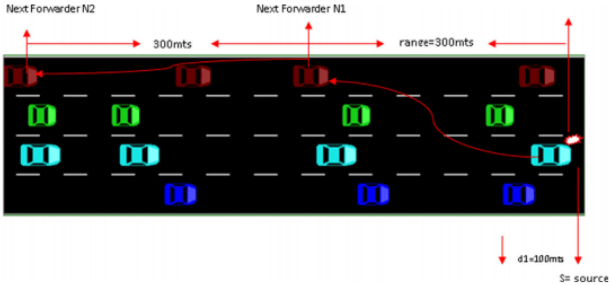

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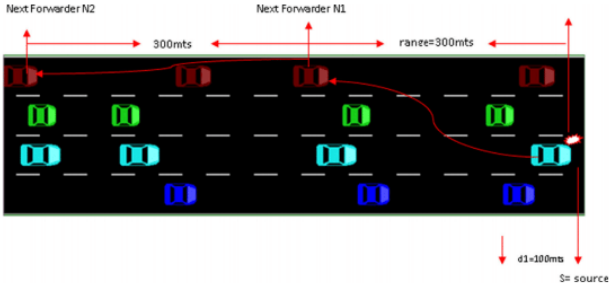

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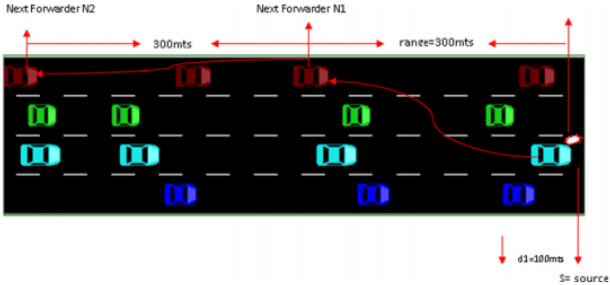

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- The performance is evaluated in a freeway scenario, and the results were compared with Non-Fuzzy-based system as (Greedy forwarding protocol (GFP), Most forward within Radius (MFR), Multipoint Relay (MPR), Flooding, etc.) in terms of efficiency.

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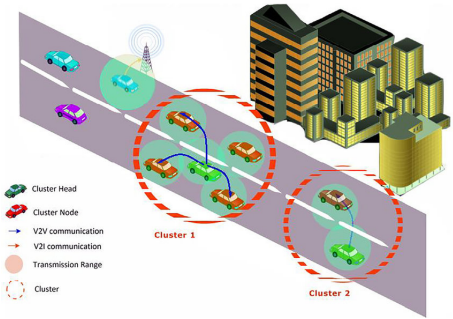

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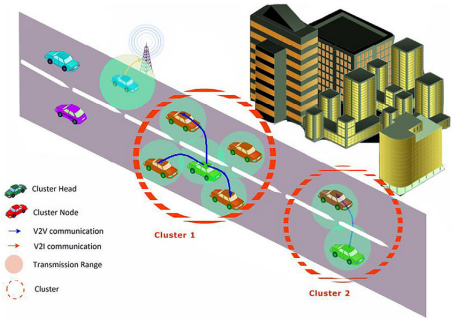

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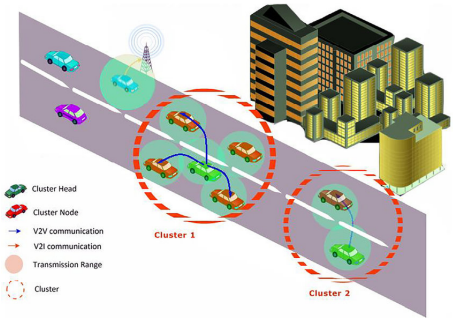

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- Comparatively, the approach is *more effective, maintains the stability of the cluster and reduces the network congestion*.

A comprehensive survey: Benefits, Services, Recent works, Challenges, Security and Use cases for SDN-VANET [SAHZI+20]

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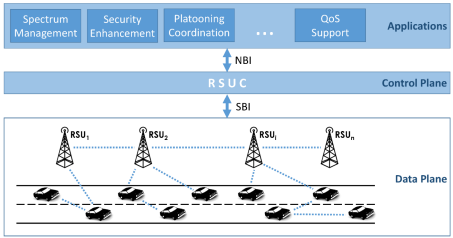

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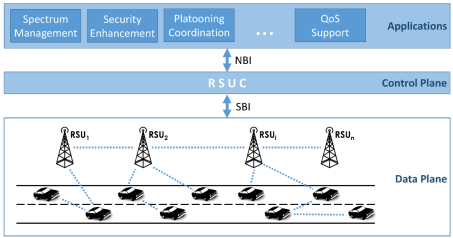

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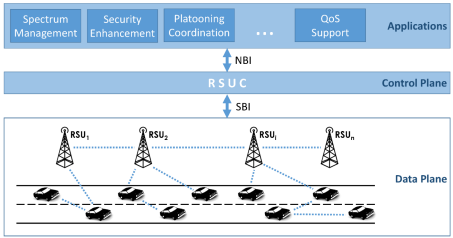
- The use of separation between the control and data planes in VANET allows the network intelligence and state to be in the center.



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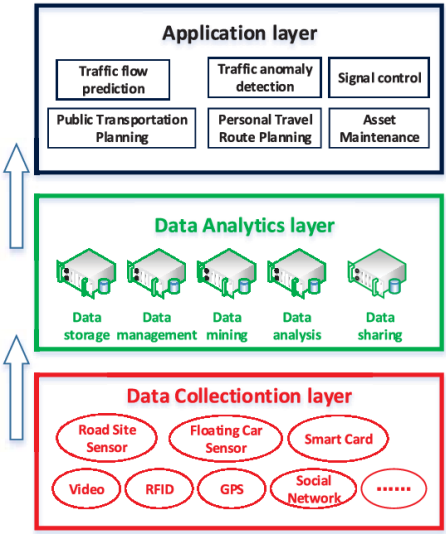

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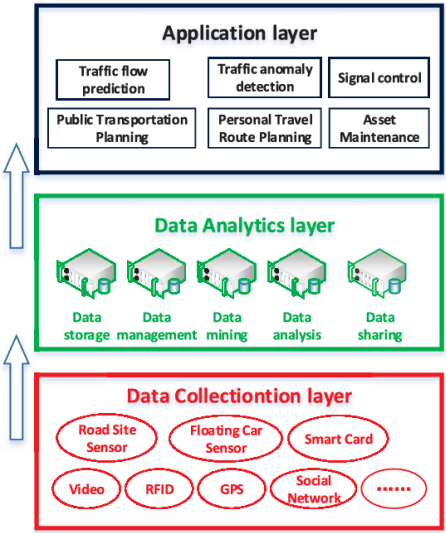

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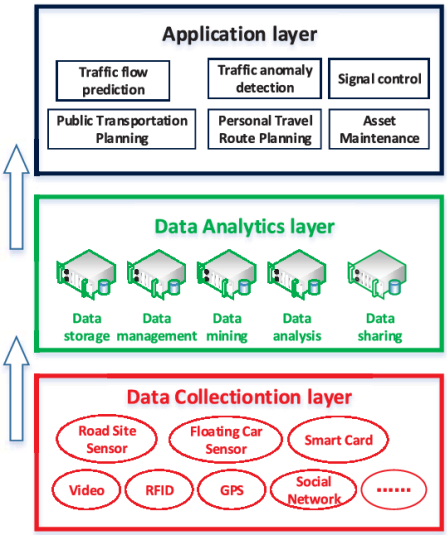
3. **Application Layer:** this layer is where all the results of the previous layer is applied in the different transportation circumstances.



Applications: Designing a Smart Transportation System: An Internet of Things and Big Data Approach [JFK+19]

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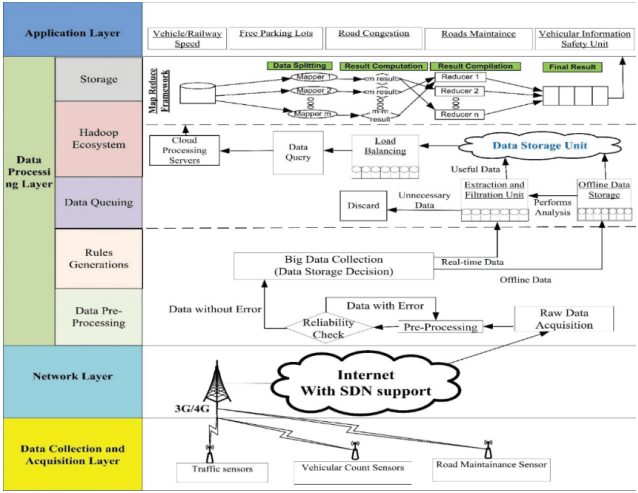
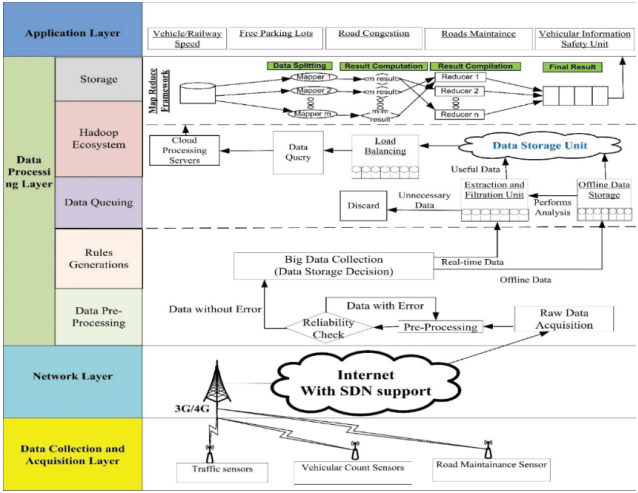


Applications: Designing a Smart Transportation System: An Internet of Things and Big Data Approach [JFK+19]

- Model for analyzing transportation data with **Hadoop** and **Spark** to handle real-time transportation data
- The system is divided into four layers: data collection and acquisition, network, data processing, and application



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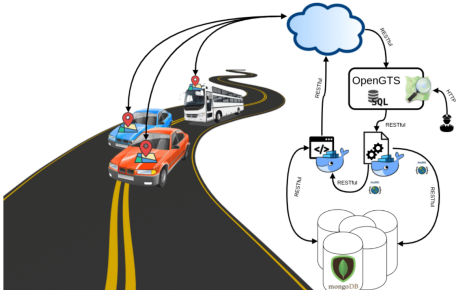

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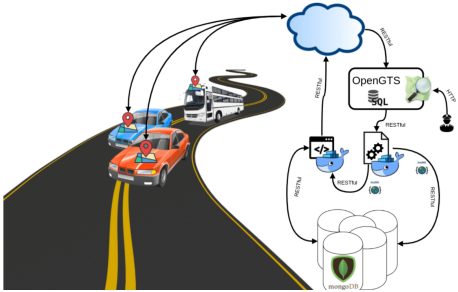
- Experiments showed that this system provides acceptable response times that allows drivers to receive alert messages in useful time so as to avoid the risk of possible accidents.



Summary of works

https://www.dropbox.com/scl/fi/1991qfy54nr8yigoclnkg/Summary.docx?dl=0&rlkey=6v8n6s56bx53u7rfugwkhrrn4

Section 3

Data Sets

Provided Data: OSM Data

Bruxelles_OSM_Transportation — Features Total: 61967, Filtered: 61967, Selected: 0

	osm_id	code	fclass	name	ref	oneway	maxspeed	layer	bridge	tunnel
1	1880377	5115	tertiary	Place Saint-Pier...	NULL	B	30	0	F	F
2	3516009	5115	tertiary	Avenue Jean So...	NULL	F	30	0	F	F
3	3516010	5115	tertiary	Boulevard du C...	NULL	F	30	0	F	F
4	3516012	5115	tertiary	Boulevard du C...	NULL	F	30	0	F	F
5	3517093	5113	primary	Quai de Willebr...	N201	F	50	0	F	F
6	3517145	5114	secondary	Avenue du Parc...	N277	B	50	0	F	F
7	3517238	5115	tertiary	Avenue des Eb...	NULL	F	30	0	F	F
8	3517239	5115	tertiary	Avenue des Ro...	NULL	B	30	0	F	F
9	3517342	5114	secondary	Place Royale - ...	NULL	F	30	0	F	F
10	3517547	5114	secondary	Rue Royale - Ko...	NULL	F	30	0	F	F
11	3517548	5114	secondary	Rue de la Loi - ...	NULL	F	30	0	F	F
12	3517549	5123	living_street	Rue de la Press...	NULL	F	20	0	F	F
13	3517550	5115	tertiary	Place des Palais...	NULL	B	30	0	F	F
14	3517630	5123	living_street	Place Saint-GÃ...	NULL	F	20	0	F	F
15	3517746	5123	living_street	Rue des Chartre...	NULL	F	20	0	F	F
16	3517840	5123	living_street	Rue de la Verdu...	NULL	F	20	0	F	F
17	3517864	5115	tertiary	Boulevard Mau...	NULL	B	30	0	F	F
18	3517865	5124	pedestrian	Rue de Bon Sec...	NULL	B	0	0	F	F
19	3517866	5124	pedestrian	Rue des Grands...	NULL	F	0	0	F	F
20	3517898	5124	pedestrian	Grand-Place - ...	NULL	B	0	0	F	F
21	3517919	5124	pedestrian	Rue de l'Ã‰tu...	NULL	F	0	0	F	F
22	4016268	5131	motorway_link	NULL	NULL	F	120	0	F	F
23	4306773	5113	primary	Rond-Point de l...	NULL	F	50	0	F	F
24	4306783	5113	primary	Avenue Frankli...	NULL	F	50	0	F	F

Provided Data: Urbis Data

Bruxelles_Urbis_Transportation — Features Total: 22845, Filtered: 22845, Selected: 0

	gml_id	beginLifes	SHAPE_Leng
7	BE.BRUSSELS.BRIC.ADM.SA.89	2015-10-05T00:00:00	0.0011297914109
8	BE.BRUSSELS.BRIC.ADM.SA.90	2015-10-05T00:00:00	0.00032031291556
9	BE.BRUSSELS.BRIC.ADM.SA.91	2015-10-05T00:00:00	0.00019878989782
10	BE.BRUSSELS.BRIC.ADM.SA.92	2015-10-05T00:00:00	0.00076784644395
11	BE.BRUSSELS.BRIC.ADM.SA.93	2015-10-05T00:00:00	0.00024966187476
12	BE.BRUSSELS.BRIC.ADM.SA.94	2015-10-05T00:00:00	0.0025098053358
13	BE.BRUSSELS.BRIC.ADM.SA.95	2015-10-05T00:00:00	0.000762084163
14	BE.BRUSSELS.BRIC.ADM.SA.96	2015-10-05T00:00:00	0.00079311385754
15	BE.BRUSSELS.BRIC.ADM.SA.97	2015-10-05T00:00:00	0.0017976410939
16	BE.BRUSSELS.BRIC.ADM.SA.98	2015-10-05T00:00:00	0.00059636186469
17	BE.BRUSSELS.BRIC.ADM.SA.99	2015-10-05T00:00:00	0.0019520394395
18	BE.BRUSSELS.BRIC.ADM.SA.100	2015-10-05T00:00:00	0.0014262266631
19	BE.BRUSSELS.BRIC.ADM.SA.101	2015-10-05T00:00:00	0.0012319555633
20	BE.BRUSSELS.BRIC.ADM.SA.102	2015-10-05T00:00:00	0.00087738937701
21	BE.BRUSSELS.BRIC.ADM.SA.103	2015-10-05T00:00:00	0.0012030375371

Section 3

Data Sets

Next Step

Next Step

- Reliable Data Dissemination Protocol for VANET Traffic Safety Applications [OMBW17]
- Fuzzy Logic-Based Forwarder Selection for Efficient Data Dissemination [BS21]

Next Step

- Reliable Data Dissemination Protocol for VANET Traffic Safety Applications [OMBW17]
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Reasons:

Next Step

- Reliable Data Dissemination Protocol for VANET Traffic Safety Applications [OMBW17]
- Fuzzy Logic-Based Forwarder Selection for Efficient Data Dissemination [BS21]

Reasons:

1. Published in highly important journals

Next Step

- Reliable Data Dissemination Protocol for VANET Traffic Safety Applications [OMBW17]
- Fuzzy Logic-Based Forwarder Selection for Efficient Data Dissemination [BS21]

Reasons:

1. Published in highly important journals
2. Recent

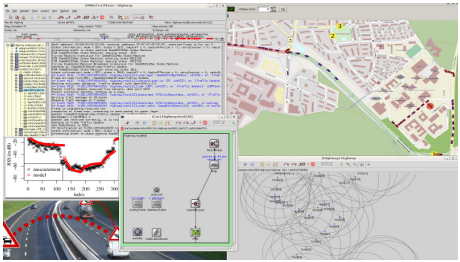
Next Step

- Reliable Data Dissemination Protocol for VANET Traffic Safety Applications [OMBW17]
- Fuzzy Logic-Based Forwarder Selection for Efficient Data Dissemination [BS21]

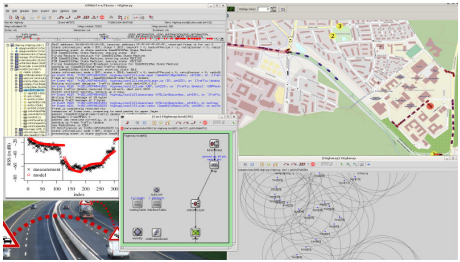
Reasons:

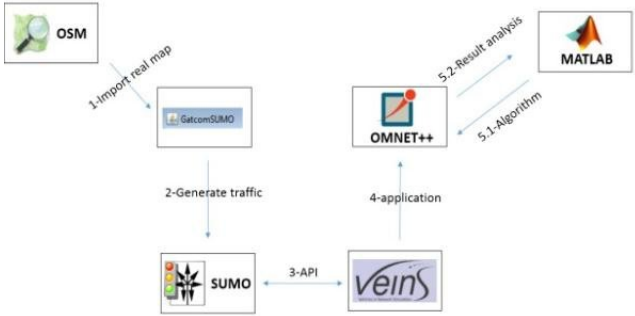
1. Published in highly important journals
2. Recent
3. Deals with similar topic

Next Step



Next Step




OSM
1-import real map
GatcomSUMO
2-Generate traffic
SUMO
3-API
veins
4-application
OMNET++
5.1-Algorithm
5.2-Result analysis
MATLAB

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Thanks!