

INTERVEHICULAR COMMUNICATION SYSTEMS

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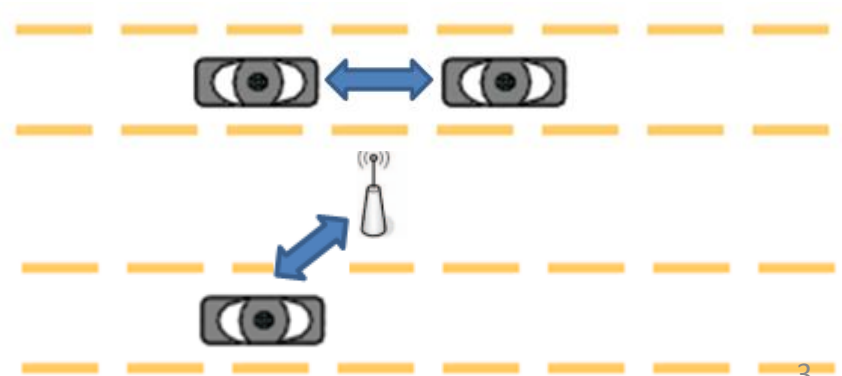
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Outline

- Introduction
- Requirements
- Topology
- OSI layers
 - MAC/PHY
 - Network
- Vehicular Collision Warning Communication Protocol (VCWC)
 - Introduction
 - Assumptions
 - Message differentiation
 - Congestion control of EWMs
- Security
- Conclusions

Introduction

- Accidents: First cause of mortality.
- 60% of the accidents could be avoided if the driver was warned in time.
- IVC systems for traffic improvement.
- FleetNet, NOW, Chauffeur.
- Two kinds of communication:
 - Vehicule to Vehicle (V2V)
 - Vehicle to Infrastructure (V2I)



Requeriments

■ Availability, reliability, safety, integrity, security.

■ LATENCY



■ SCALABILITY.



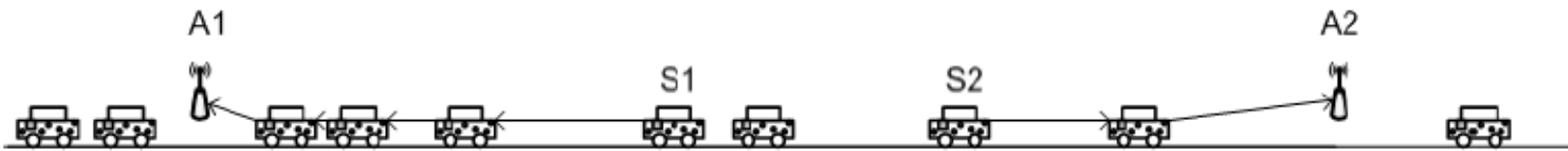
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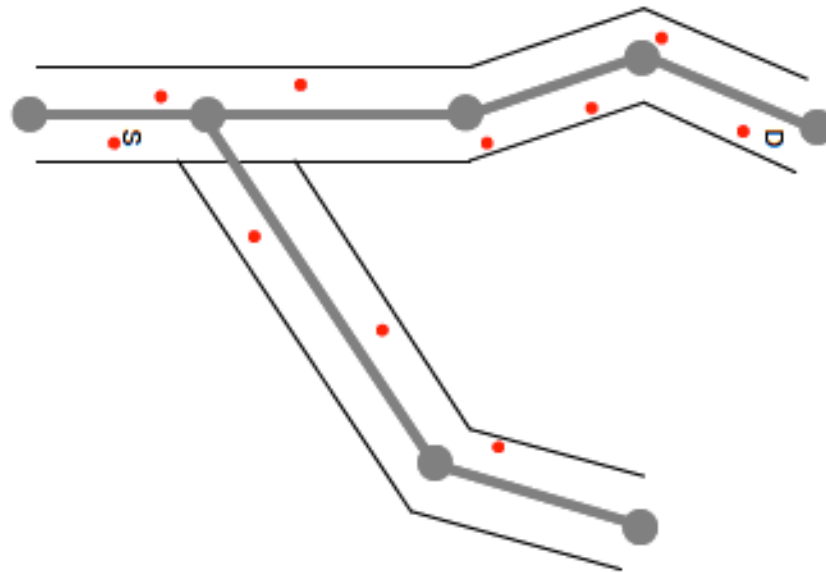
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Topology

■ Linear nature of IVC networks.



■ Not purely linear.



OSI layers

■ Physical layer.

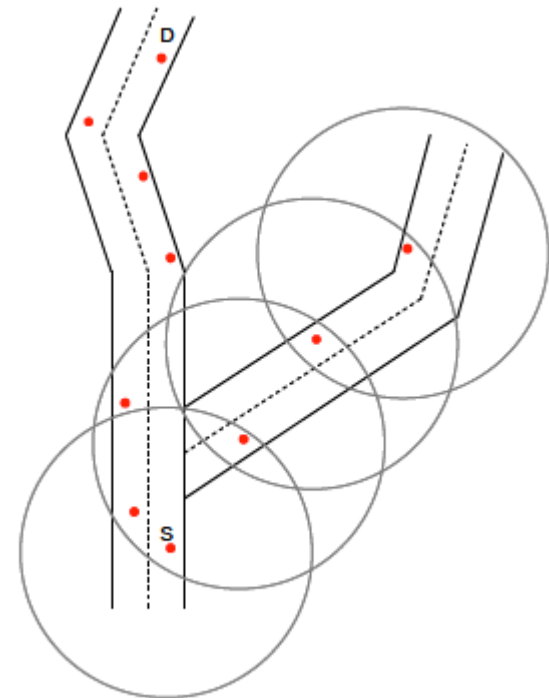
- Radio waves (micro, millimeter and VHF waves)
- Typical radio bandwidth (5.8 GHz)

■ Mac layer.

- 802.11 vs extended 3G technology.

■ Network layer.

- position-based routing protocols



■ What is VCWC?

- Vehicle Collision Warning Communication protocol
- Communication protocol for vehicles to prevent accidents
- 802.11
- V2V

■ Unreliable wireless communication (Doppler shifts, fading...)

- Retransmission strategy
- Two important terms:

Abnormal Vehicle (AV)

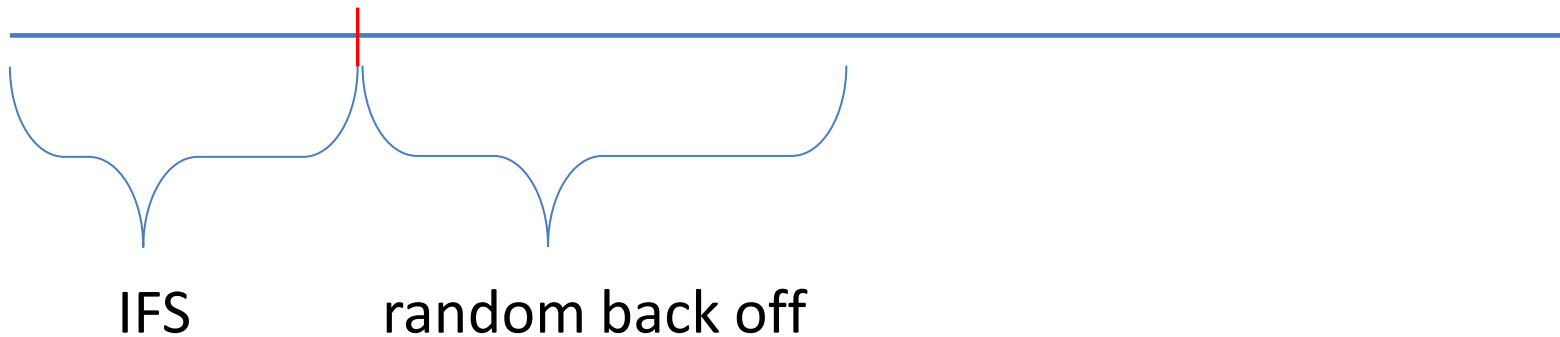
Emergency Warning Message (EWM)



- Every vehicle is equipped with a system that provides geographical position information (i.e. GPS)
- Every vehicle has a wireless transceiver.
- Every vehicles use the standard 802.11 and share a common channel. (multichannel approaches?)
- Even when not every vehicle in the road is using VCWC, the VCWC brings benefit to all vehicles.

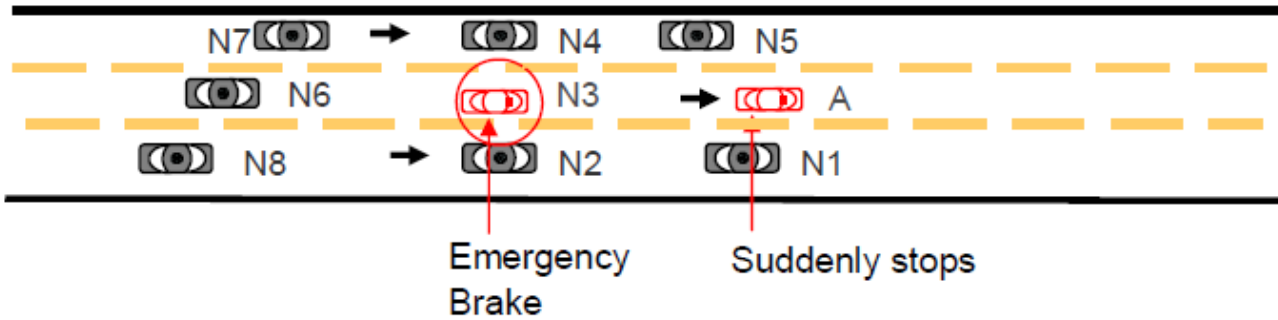
- Three levels of priorities:
 - EWMs
 - Forwarded EWMs
 - Non-time-sensitive messages

- Media Access. The Interframe Space (IFS).



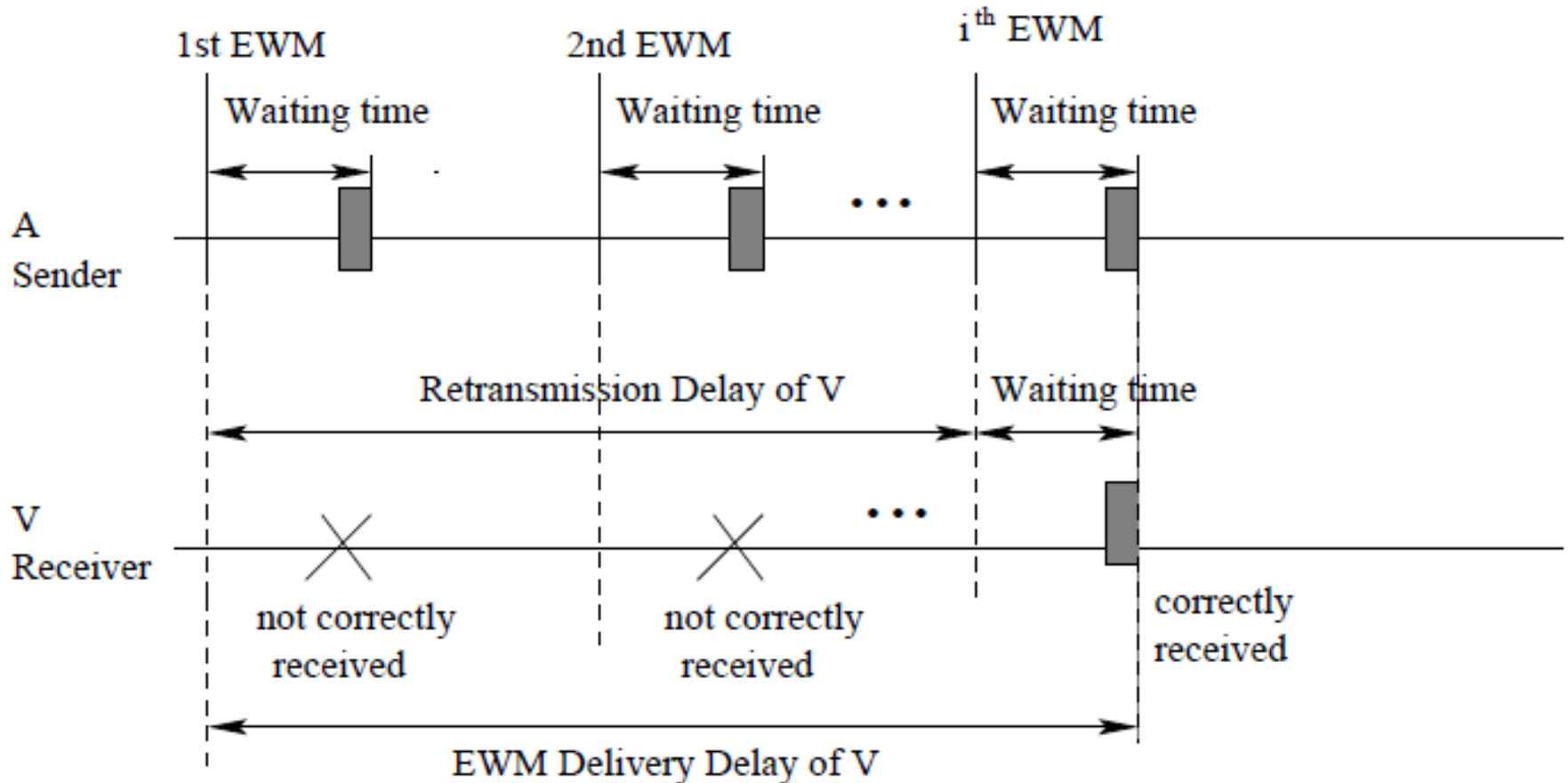
VCWC Communication Protocol

Congestion control of EMWs



VCWC Communication Protocol

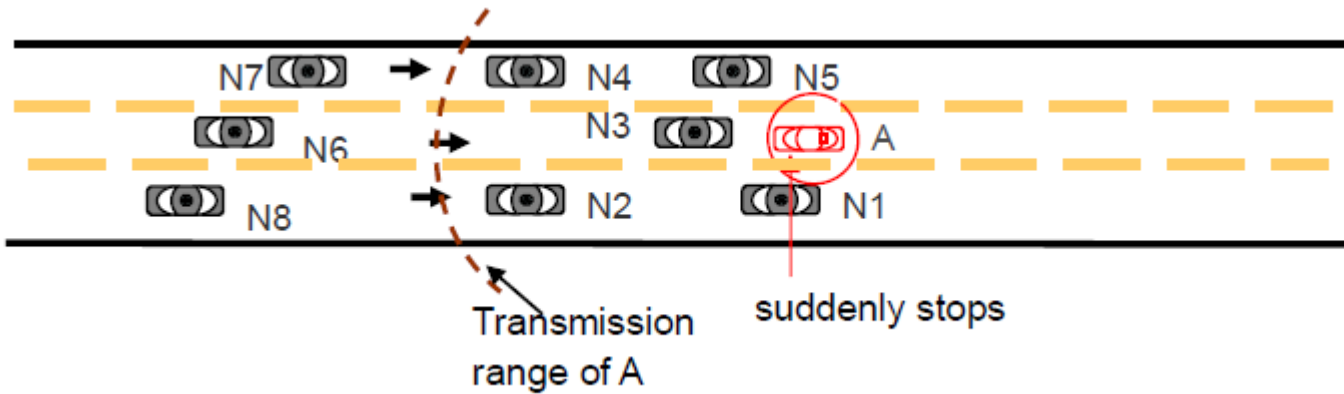
Congestion control of EMWs.



$$Delay = Delay_{wait} + Delay_{retransmission}$$

VCWC Communication Protocol

Decreasing algorithm.



- Multiplicative rate decreasing algorithm:

$$F(\lambda_0, k) = \max(\lambda_{min}, \lambda_0/a^{k/L})$$

- A lot of attacks become possible.
- Security is very challenging in IVCs (high volatility, delay...)
- Password-based system?



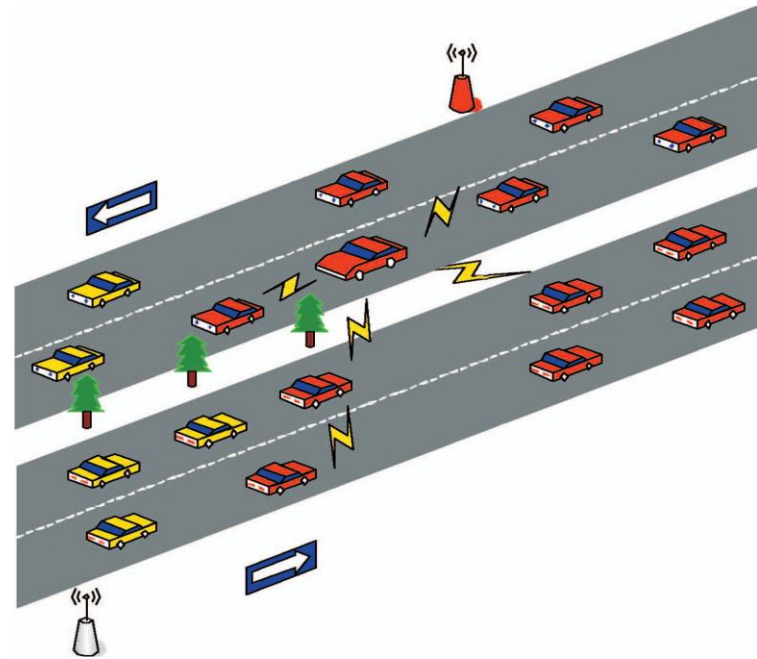
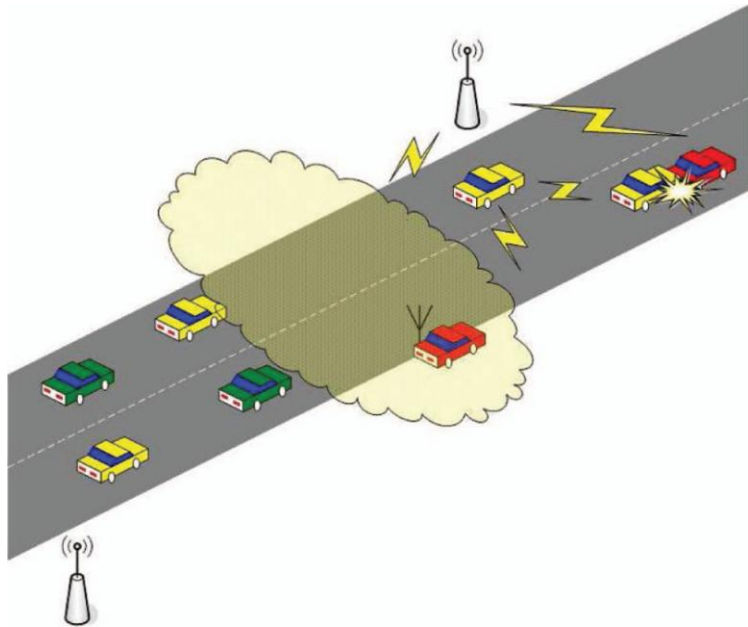
PASSWORD_REQ



PASSWORD_SEND

- Interference generation
- Sending of false information
- Message manipulation (drop, corrupt, modify, replay...)
- Impersonation
- Private information

VCWC Communication Protocol Security



- Cryptography
- Authentication, authorization and accounting
- vehicular public key infrastructure

- IVC systems is an emerging area
- Important source of research
- IVC networks present a difficult scenario
- Security is essential.



THANK YOU!



REFERENCES

- [1] Jawhar, I., Mohamed, N., Zhang, L.: Inter-Vehicular Communication Systems, Protocols and Middleware. pp. 1--3 (2010)
- [2] Yang, X., Liu, J., Zhao, F., Vaidya N. H.: A Vehicle-to-Vehicle Communication Protocol for Cooperative Collision Warning. pp 1--14. (2003)
- [3] Thangavelu, A., Saravanan, K. Rameshbabu, K.: A Middleware Architectural Framework for Vehicular Safety over VANET (InVANET). pp 277--282 (2009)
- [4] Luo, J., Hubaux, J.: A survey of Inter-Vehicle Communication. pp 1--12. (2004)
- [5] Böhm, A.: State-of-the-art in networks aspect for Inter-Vehicle communication. pp 1--25. (2007)
- [6] Keskin, U.: In-Vehicle Communication Networks: A literature Survey. pp 14 (2009).
- [7] Nekovee., M.: Quantifying Performance Requirements of Vehicle-to-Vehicle Communication Protocols for Rear-end Collision Avoidance. pp 1--5. (2008)
- [8] Papadimitratos., P., Raya, M., Hubaux, J.P.: Securing Vehicular Communication. pp 8--16 (2006) IEEE
- [9] Kung, A., Buttyan, L., Kargl, F., Papadimitratos., P., Raya, M., Hubaux, J.P.: Architecture for Secure and Private Vehicular Communications. pp 1. (2007)