



Vehicle to Vehicle Communication Protocols: Creating a Safer Commute

BY: SAHIL GANDHI

LAB 4, FALL 2016

TA: THUY VU

Problem

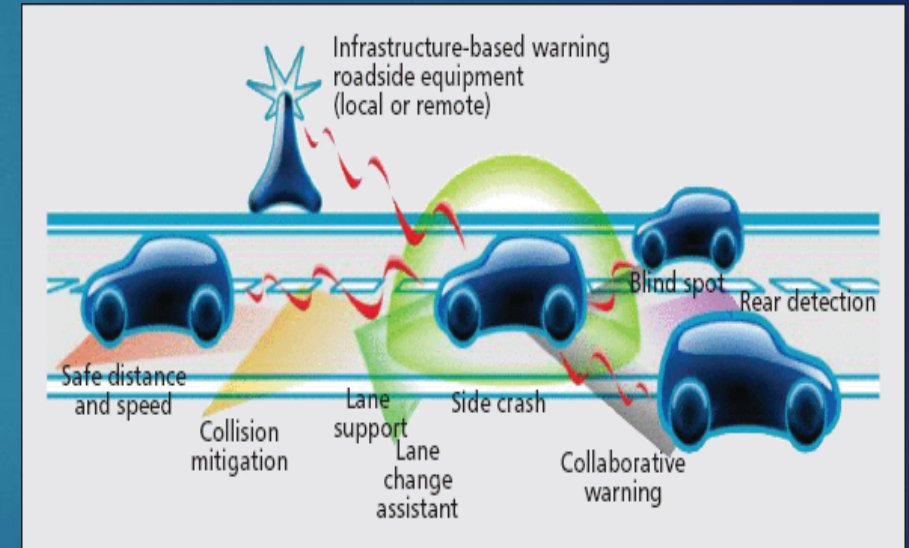
- ▶ 94% of all crashes due to human error [1]
- ▶ Difficult to train human beings to:
 - ▶ Not look at phone
 - ▶ Not get distracted
 - ▶ Not be stressed
 - ▶ Not be intoxicated
- ▶ Semi-autonomous makes it worse
 - ▶ Even less focus on road

Solution

- ▶ Constant factor on road – the car
 - ▶ Press pedal = accelerate
 - ▶ Press brake = slow/stop
 - ▶ Turn steering = turn left/right
- ▶ Far easier to control -> V2V comm.
- ▶ Dedicated Short Range Communication (DSRC)
 - ▶ Exchange data (speed, location, etc.)
 - ▶ 10 messages per car per second up to 1000 feet [1]

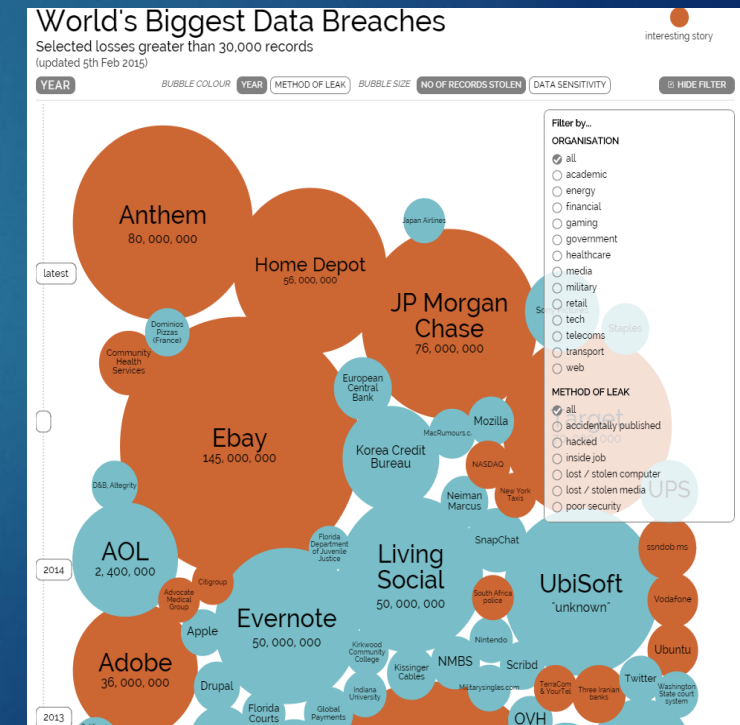
Pros of V2V Comm.

- ▶ Collision Detection -> Car A colliding into Car B:
 - ▶ Slow Car A, speed Car B to avoid hit
- ▶ Accident Mitigation:
 - ▶ Use above step to avoid accident
 - ▶ Else: signal cars behind to slow down
 - ▶ Assist in changing lanes to block a jam
 - ▶ Reduce commute times greatly in cities
- ▶ Even more benefits to be found!



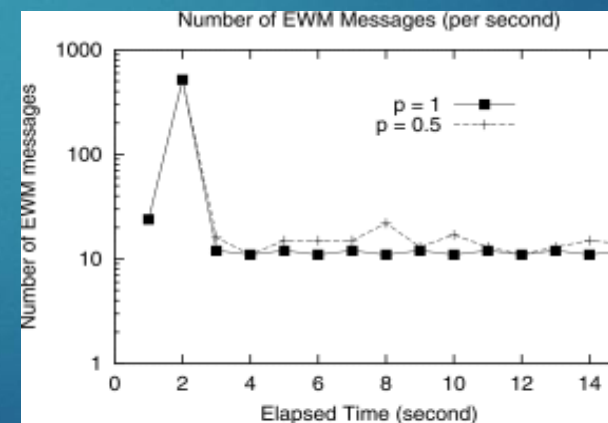
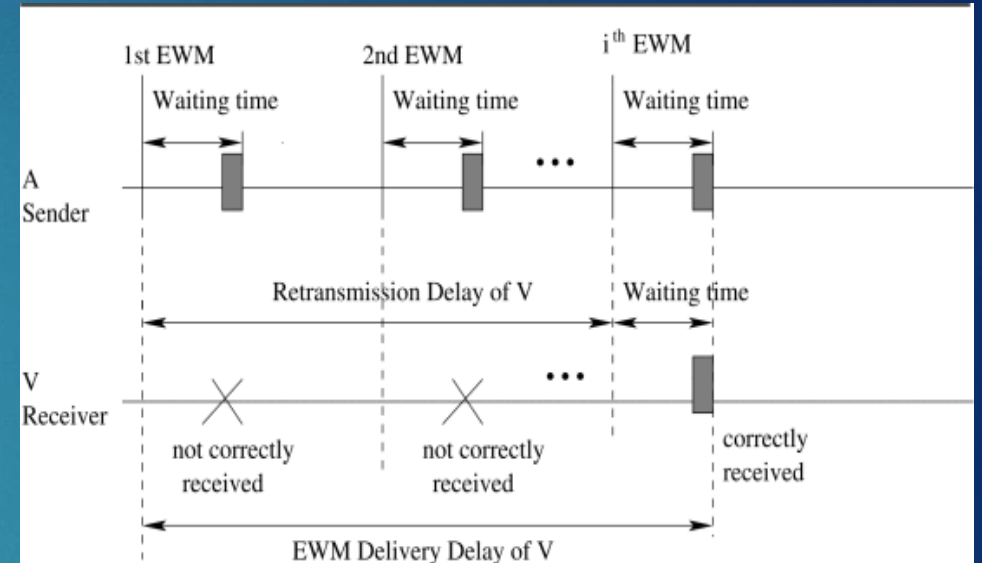
Cons of V2V Comm.

- ▶ More connected devices = more security needed
 - ▶ Difficult to maintain security -> Latest IOT Hack is example!
- ▶ Lots of data generated and transmitted
 - ▶ Can be an intrusion of privacy
- ▶ Other unintended side effects
 - ▶ People more distracted than ever
 - ▶ Can control be passed to user safely?

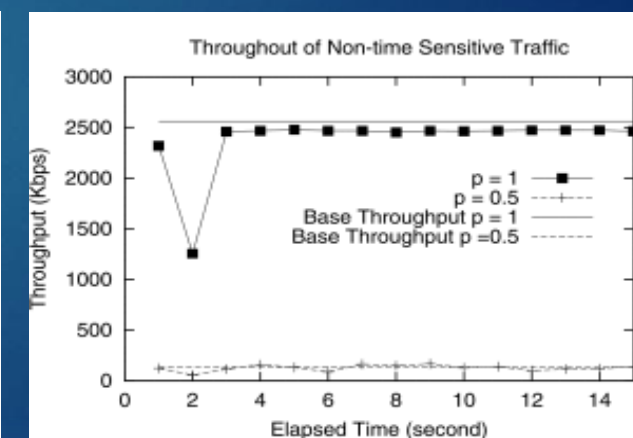


Current Research

- ▶ Dealing with signal propagation delay:
 - ▶ Hardware plus software can create these delays
 - ▶ Modeled by: $\lambda = \text{arrival rate of messages}$,
 $\mu = \text{rate at which channel can process messages}$
 - ▶ $Delay_{wait} = \frac{1}{\mu - \lambda} + \frac{1}{\mu} [4]$.
- ▶ Separate queues for different messages
 - ▶ EWMs in a priority queue [4]
 - ▶ Deal with EWMs first till event is over
 - ▶ Sensitive information processed first
 - ▶ Safer handling + less delays



(a) Number of EWMs (Per Second)



(b) Throughput of Non-time Sensitive Traffic (Per Second)

Conclusion

- ▶ V2V still needs much research
- ▶ Obstacles: Privacy + Security
- ▶ Benefits: Safer roads, less accidents!
- ▶ Google, Tesla, Uber, etc. working on it!
- ▶ Semi-autonomous/autonomous != V2V!



Questions?

References

[1] Peng, Huei. "Saving Lives by Letting Cars Talk to Each Other." *The Conversation*. N.p., 11 Sept. 2016. Web. 16 Nov. 2016. <<https://theconversation.com/saving-lives-by-letting-cars-talk-to-each-other-59221>>

[2] Papadimitratos, Panos, et al. "Vehicular communication systems: Enabling technologies, applications, and future outlook on intelligent transportation." *IEEE Communications Magazine* 47.11 (2009): 84-95.
<<http://ieeexplore.ieee.org/document/5307471/?arnumber=5307471>> DOI = 10.1109/MCOM.2009.5307471

[3] Sander, Jason. "History's Worst Data Breaches." *CloudTweaks*. N.p., 23 Feb. 2015. Web. 20 Nov. 2016. <<http://cloudtweaks.com/2015/02/historys-worst-data-breaches/>>.

[4] Yang, Xue, et al. "A vehicle-to-vehicle communication protocol for cooperative collision warning." *Mobile and Ubiquitous Systems: Networking and Services*, 2004. MOBIQUITOUS 2004. The First Annual International Conference on. IEEE, 2004.
<<http://ieeexplore.ieee.org/document/1331717/?arnumber=1331717&tag=1>> DOI = 10.1109/MOBQ.2004.1331717