embedded VISION SUMMIT 2018

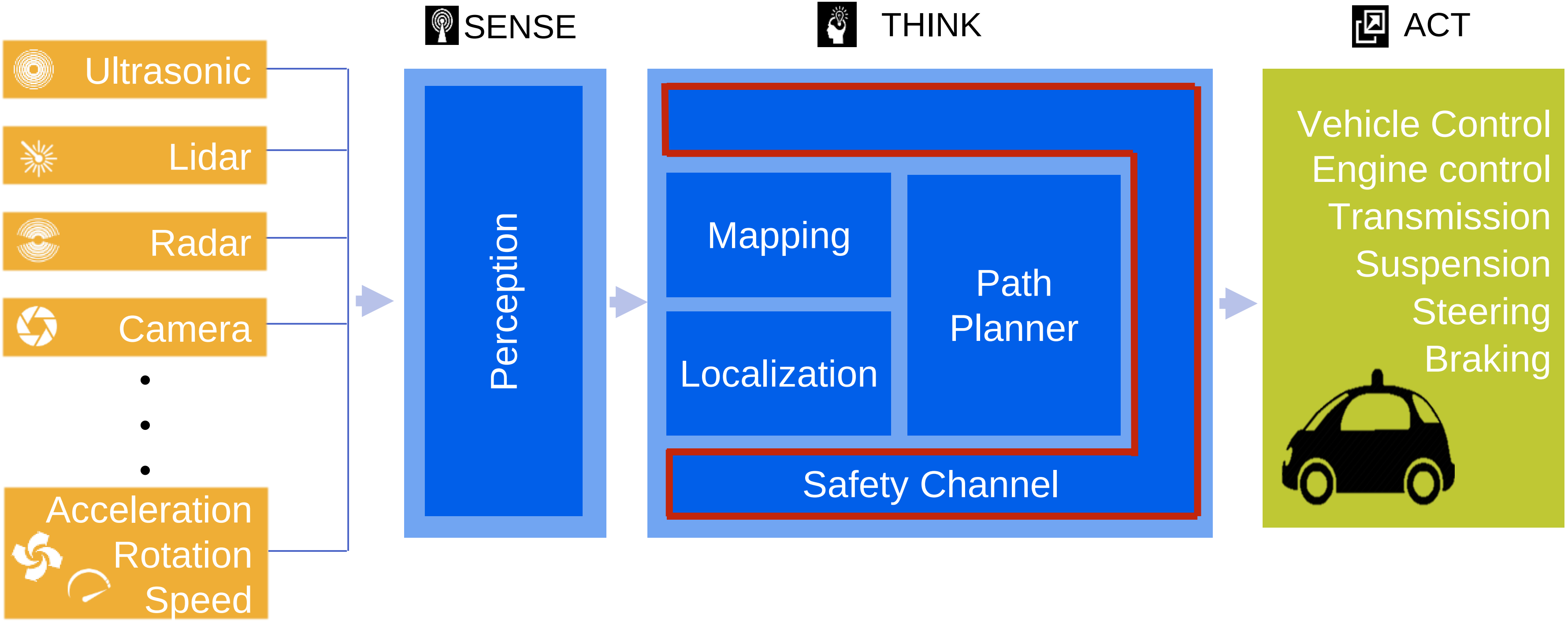
Role of the Cloud in Vision Processing for Autonomous Vehicles

NXP

Ali Osman Ors

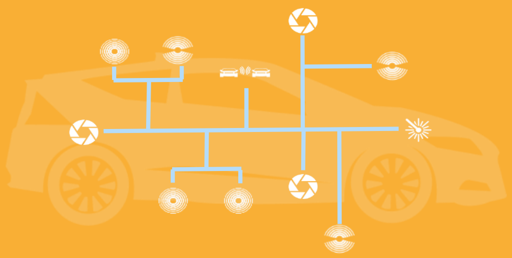
May 22, 2018

Basic Autonomous Vehicle System



Architecture Topologies

Distributed
No central fusion unit

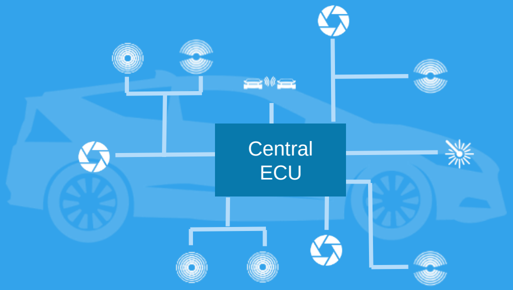


Least likely

Redundant ECUs

- Lower BW for ‘fused’ data to be exchanged
- Increased sensor costs and complexity

Centralized
Central server and simple sensors

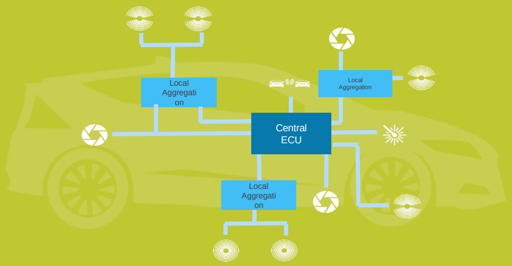


Likely

Complexity vs. Cost

- Best Sensor Data fusion in theory
- Extra large BW for raw data movement

Hybrid
Central fusion & smart sensors



Most likely

Flexible and Scalable

- Leverage Smart Sensing and Local Aggregation
- Manages costs of Data distribution vs. precision for fusion

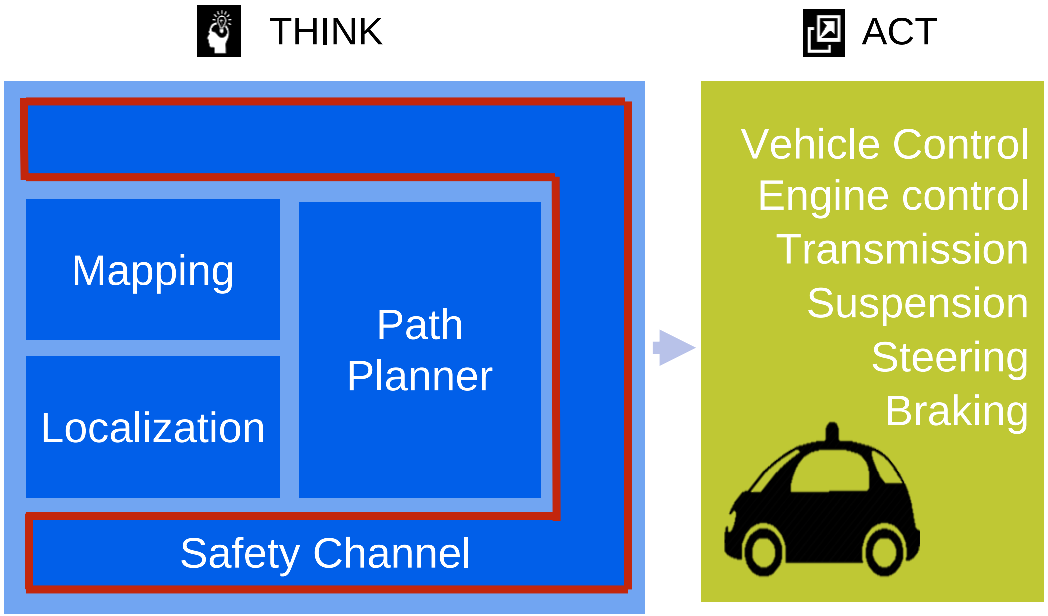
The Cloud

- Offload
- Update
- Store

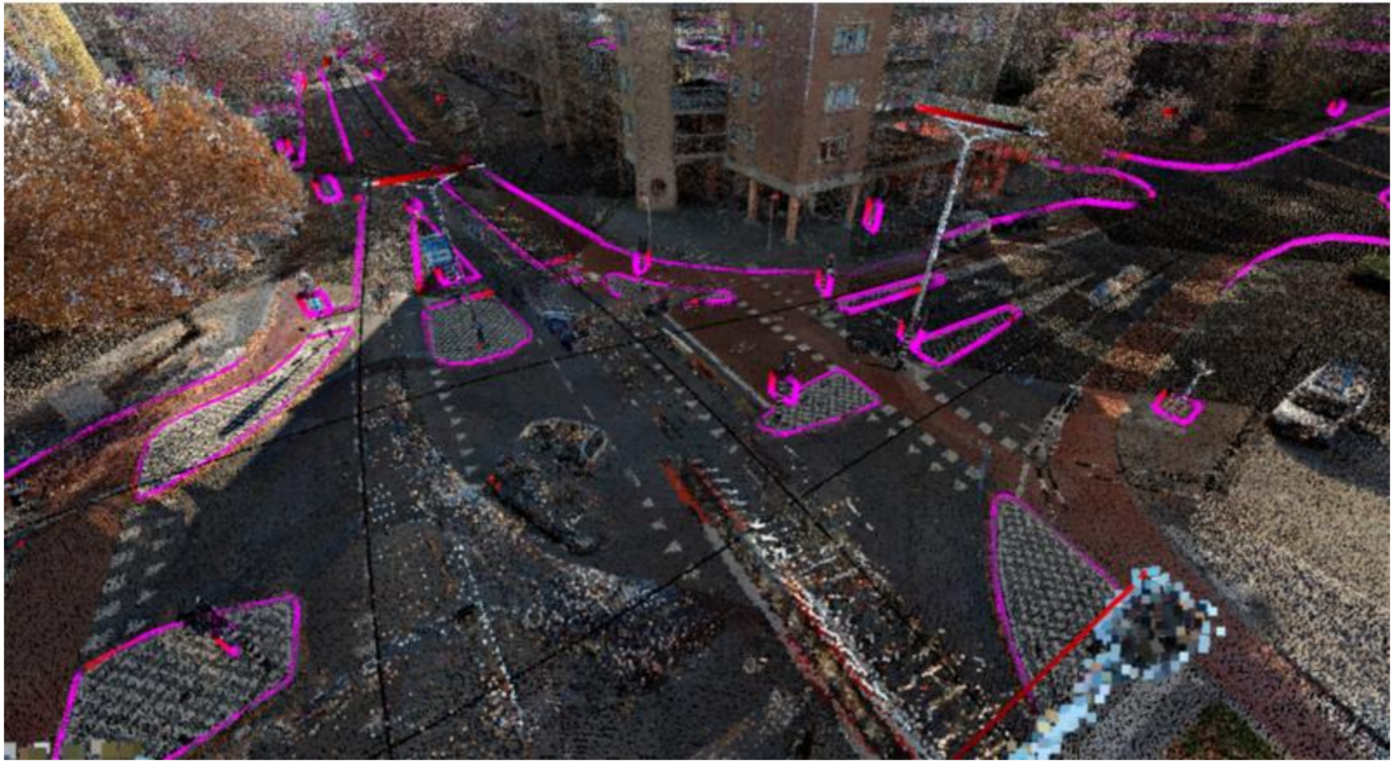
The Cloud for Autonomous Vehicles

- Offload
- Update
- Store

Planner Failures



Annotated Maps



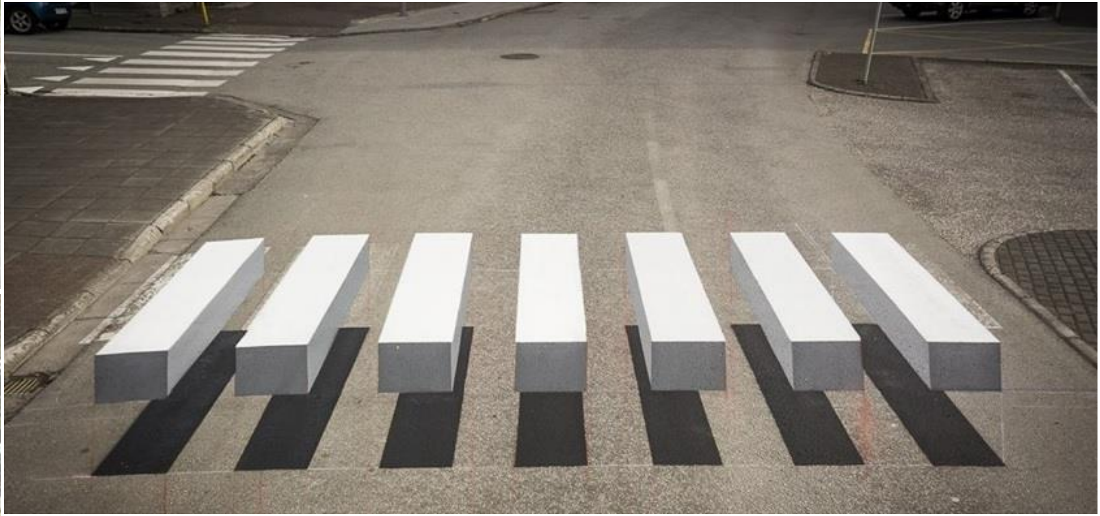
*Civil Maps

NXP

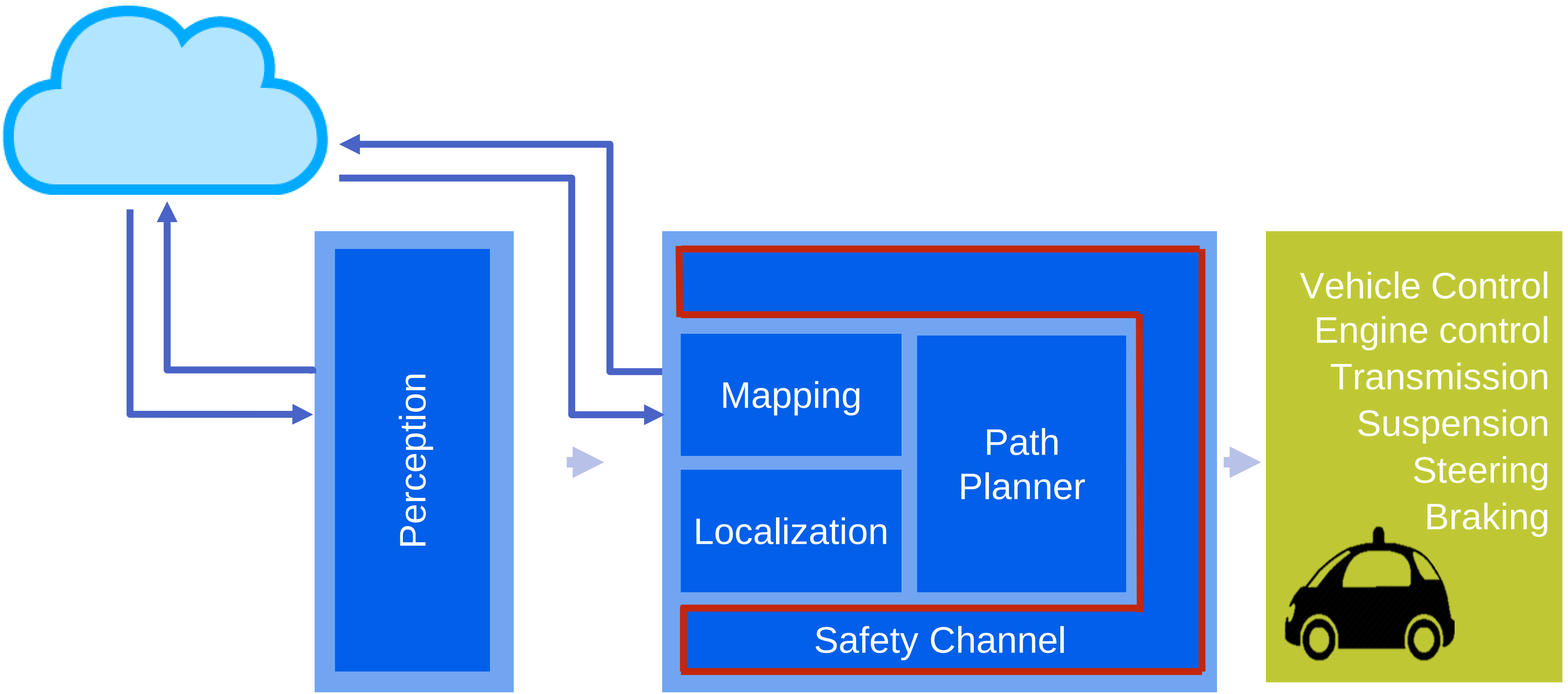
If You Hear Hoofbeats

Potholes and Snow

Optical Illusions



OTA Updates



Perception
Mapping
Localization
Path Planner
Safety Channel
Vehicle Control
Engine control
Transmission
Suspension
Steering
Braking

OTA Updates

<u>Benefits :</u>

– Ability to modify applications to increase safety and security level of the car

– Allow addition of improved features, post-purchase

<u>Demands:</u>

– Minimal affect on drivers (e.g. minimal/no vehicle down time during update)

– No risk of failed update leaving car unusable

– Security to prevent rogue updates/IP theft

Data Needs

Sensor Type	Data Generated per Sensor (Mbps)	Sensor Count on L3+ AV	BW Needed (MB/s)
Camera	700-6000	4-12	300-6000
Lidar	20-100	1-6	5-60
Radar	1-15	2-8	1-15

- > 3GB/s data generated
- 35 sec. event recording for a disengagement or classification flag

~100GB per event to be uploaded

Time Cost

	802.11p (DSRC)	4G-LTE (Cellular)	802.11ac (Wi-Fi)
Throughput	~3.4MB/s	~10MB/s	~80MB/s
Time to update 6.7MB of NN Weights	2 sec	0.7 sec	0.08 sec
Time to upload 100GB event	8 hours	2.8 hours	21 min

Driver Monitoring and Scoring


* Dreamworks Pictures


* Edgetensor Technologies

Take Aways

- Cloud services and connectivity is important to an AV for quality of service, but cannot be essential
- Vision processing at the edge is timing critical and cannot be offloaded to—but can be augmented via—the cloud
- Connectivity time and cost will be significant factor

Resources

NXP's S32 Automotive Platform for ADAS and AV systems with secure OTA updates:
https://www.nxp.com/products/processors-and-microcontrollers/arm-based-processors-and-mcus/s32-automotive-platform:S32

Liu, S. & Tang, J. & Wang, C. & Wang, Q. & Gaudiot, J.
"Implementing a Cloud Platform for Autonomous Driving"
https://arxiv.org/abs/1704.02696

Zhigang X. & Xiaochi L. & Xiangmo Z. & Michael Z. & Zhongren W.
"DSRC versus 4G-LTE for Connected Vehicle Applications: A Study on Field Experiments of Vehicular Communication Performance"
https://doi.org/10.1155/2017/2750452

Amazon AWS for Automotive
https://aws.amazon.com/automotive/autonomous-driving/

Thank You