Building Infrastructure for Self-Driving Cars

Martin Velez

Uber ATG

Agenda

01 Introduction
02 Self-Driving
03 Infrastructure
04 My Road to Uber
05 Interview Tips

Martin Velez

Software Engineer

Uber ATG

ATG Storage Infrastructure Team

San Francisco

Joined Uber on October 2018

martin.velez@uber.com

Photo Credit: https://static1.squarespace.com/static/5a70a23b90bcce7e9fef1559/t/5a71080bec212dcf0febbbe0/1518566672217/Aerial-Opp.png

Pier 70 Office

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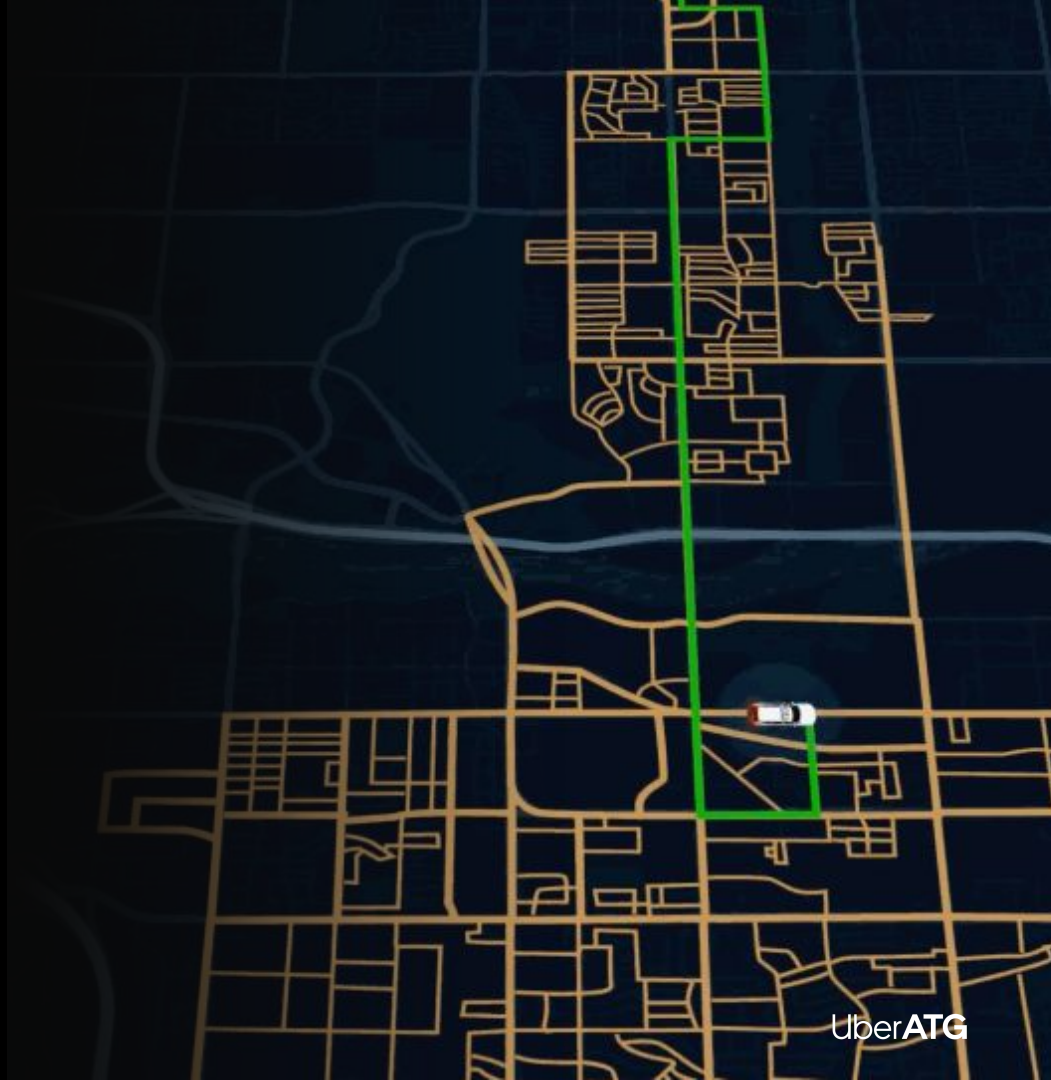
ATG Mission

Introduce self-driving technology to the Uber network in order to make transporting people and goods safer, more efficient, and more affordable around the world.



Why Self Driving?

Self-driving matters for the world

Save lives. Save time. Save space.

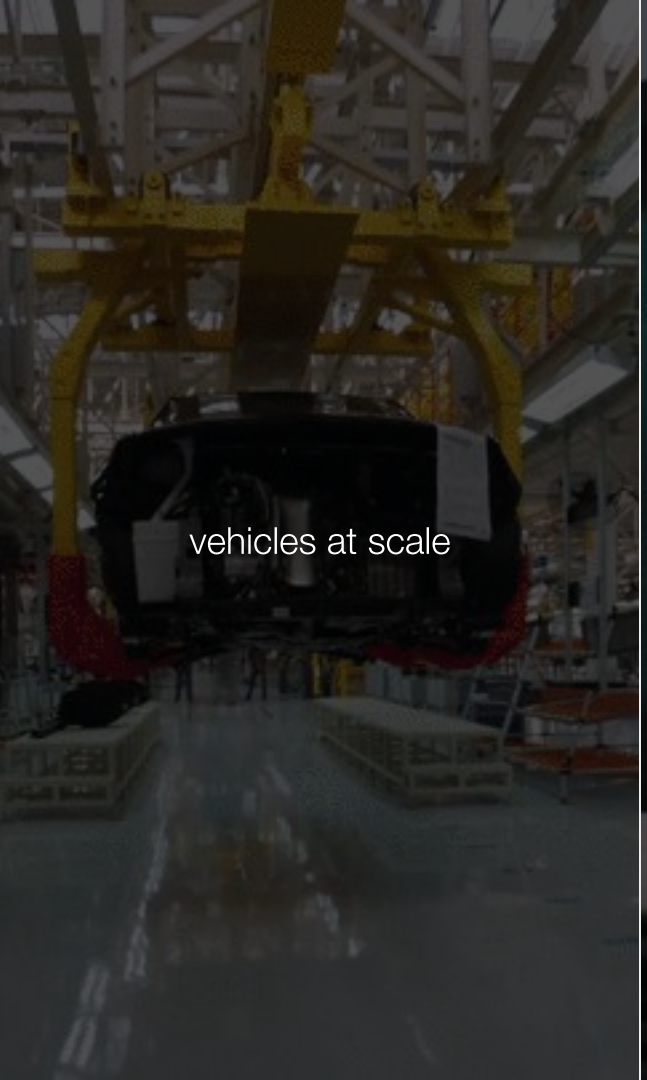
Self-driving matters for Uber

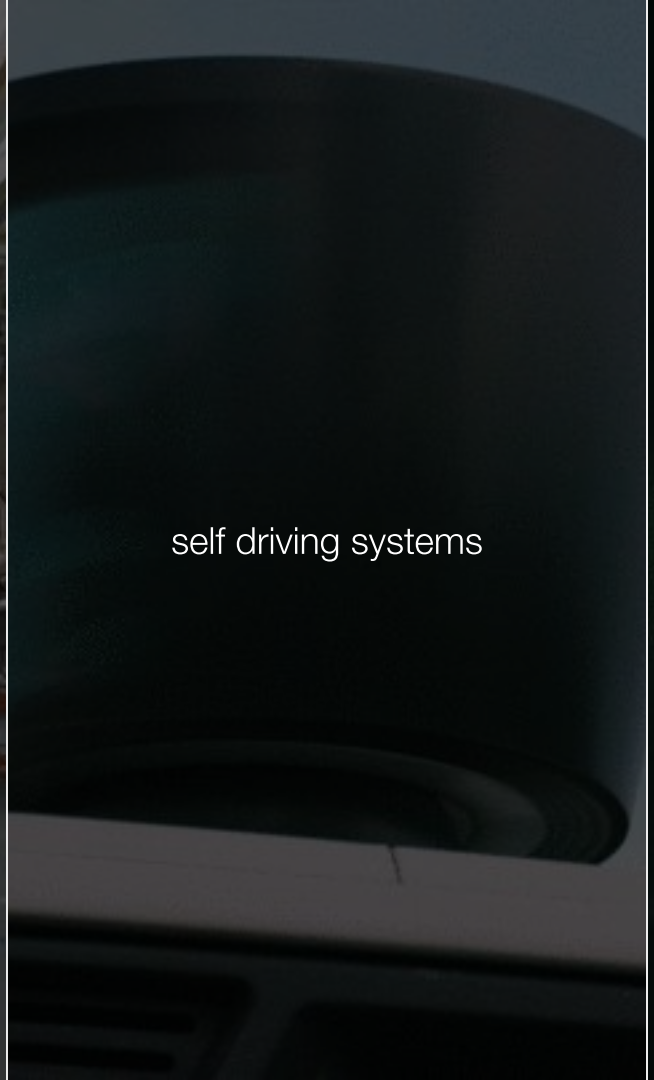
Providing safe, reliable, cost effective transportation is our priority.

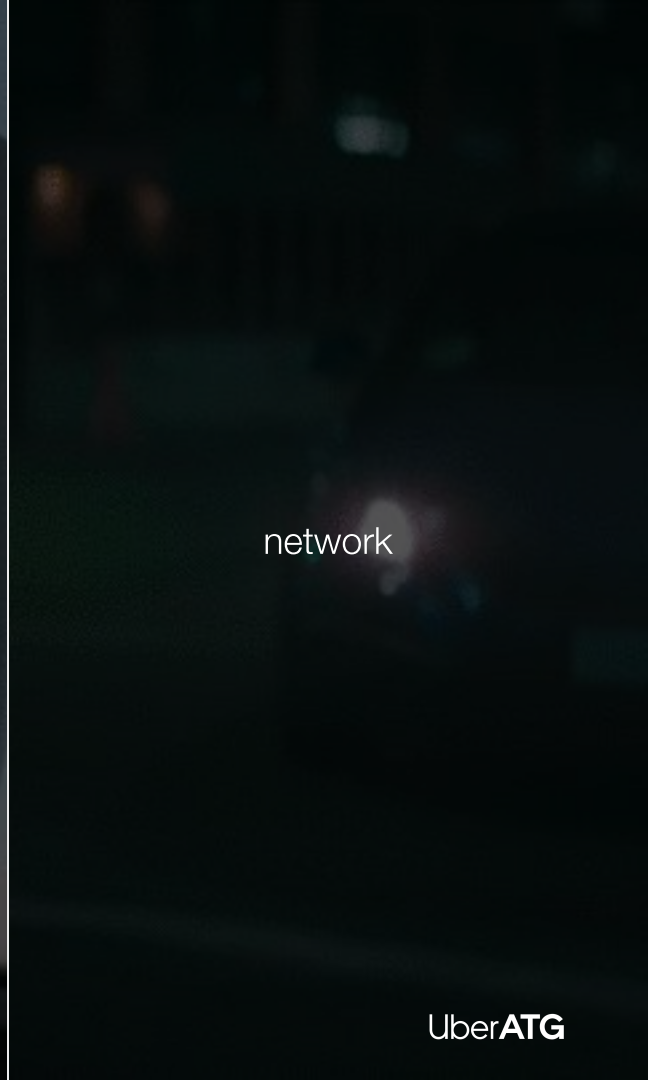
Uber matters to self-driving

Our network allows us to scale self-driving globally.

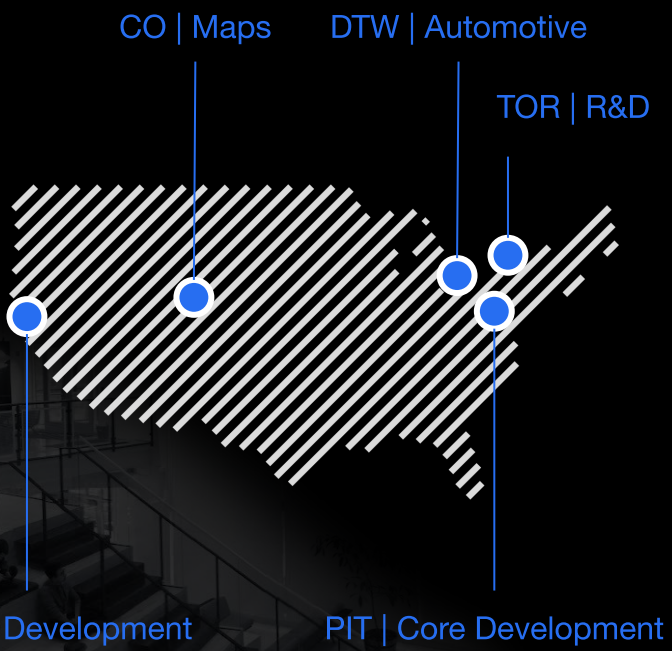
UberATG


vehicles at scale


self driving systems


network
UberATG

By Location



5 Offices

1000+ Employees

Safety

Product | User Experience

Program Management

Systems Engineering and Testing

Software Engineering

Hardware Engineering

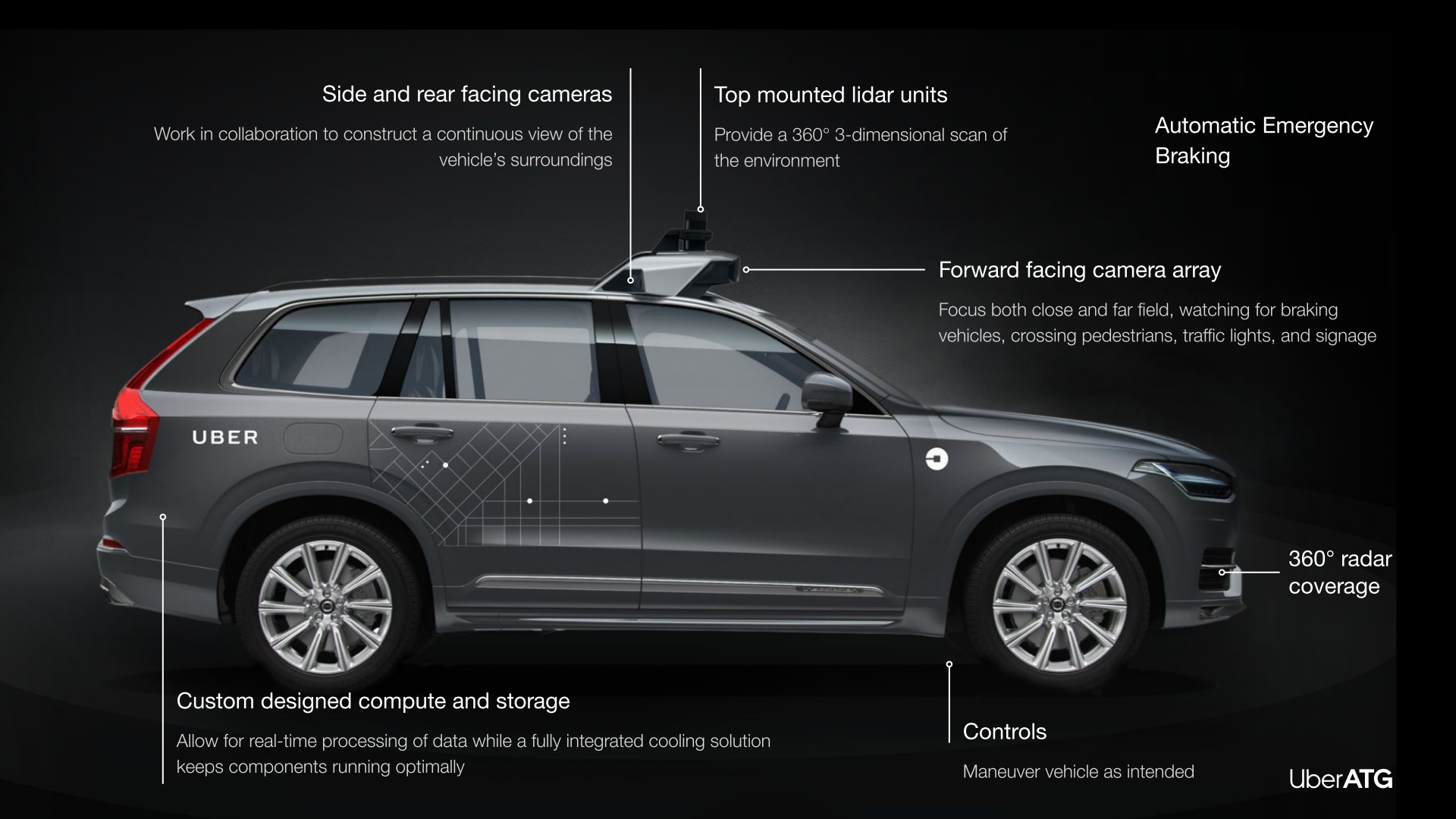
Vehicle Programs

Strategy

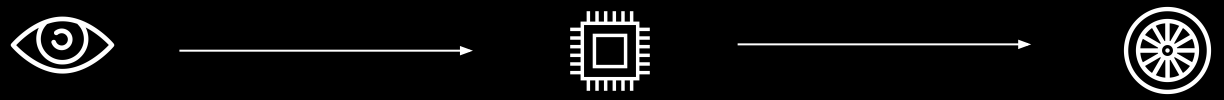
UberATG

Team Overview

Software	Build self-driving capability for cars and trucks though autonomy & supporting software development
Mapping	Create AV maps required for autonomy by using HD map data and Uber Maps
Hardware	Design, prototype, and integrate hardware into OEM vehicles that can be produced at scale
Vehicle Programs	Build relationships with the world's top OEMs and Tier 1 suppliers to partner in self-driving innovation and integration
Operations	Maximize self-driving vehicle utilization in order to deliver the miles and trips needed for autonomy and product development
Product	Develop & deliver magical customer products through real world-testing & iteration
Safety	Define & prove better than human performance from AVs.


Side and rear facing cameras
Work in collaboration to construct a continuous view of the vehicle's surroundings
Top mounted lidar units
Provide a 360° 3-dimensional scan of the environment
Automatic Emergency Braking
Forward facing camera array
Focus both close and far field, watching for braking vehicles, crossing pedestrians, traffic lights, and signage
UBER
360° radar coverage
Custom designed compute and storage
Allow for real-time processing of data while a fully integrated cooling solution keeps components running optimally
Controls
Maneuver vehicle as intended
UberATG

SDV Basics



Camera	Perception	Steering
LiDAR	Prediction	Braking
Radar	Motion Planning	Propulsion
Ultrasonic	Control	
GPS	Maps	
IMU	Localization	
Wheel Encoder	Routing	

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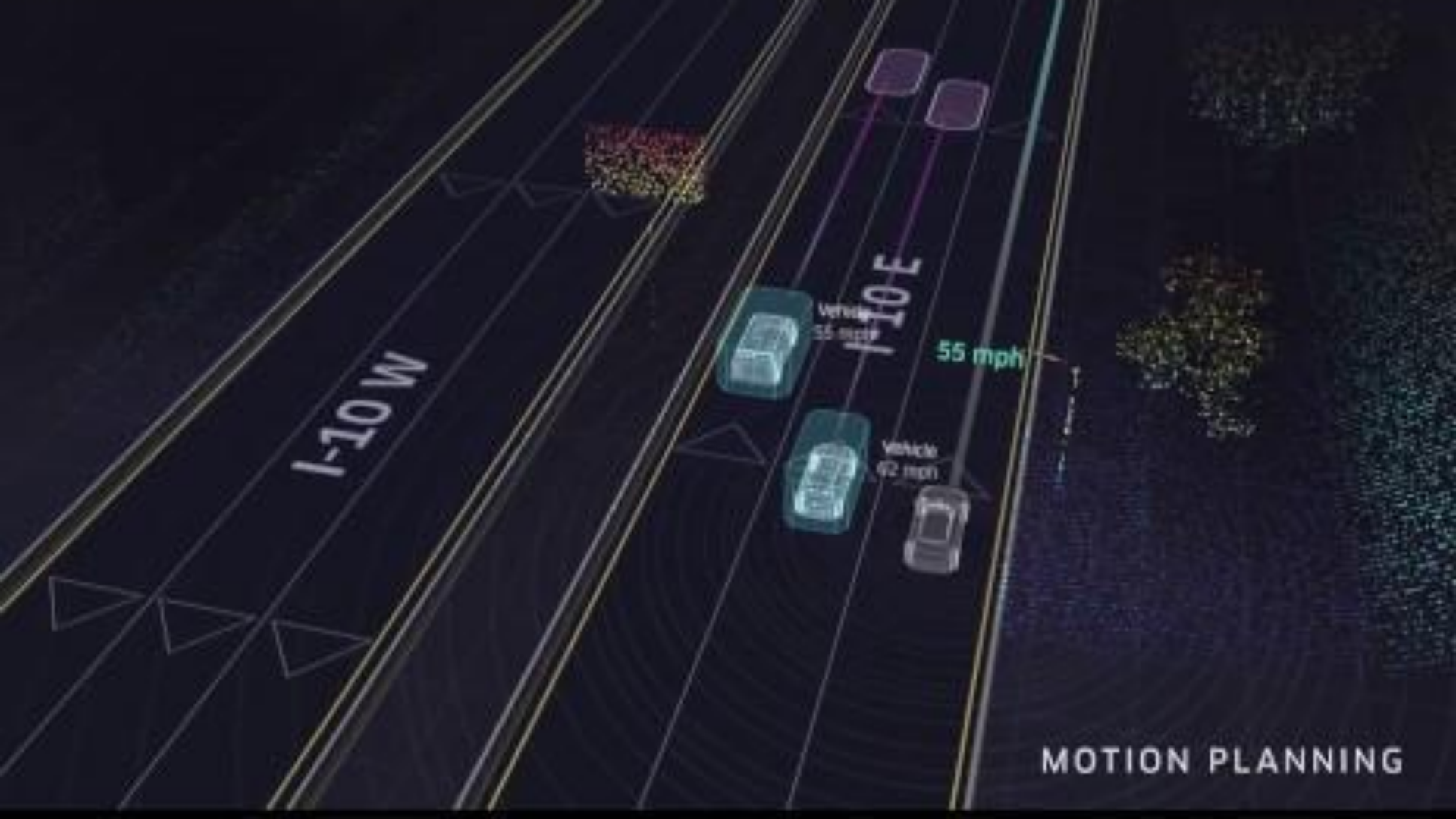
I-10 W
I-10 E
MAP


LOCALIZATION


LIDAR
PERCEPTION


I-10 W
I-10 E
Vehicle
56 mph
Vehicle
62 mph
PREDICTION


I-10 W
I-10 E
55 mph
MOTION PLANNING


I-10 W
I-10 E
Vehicle
56 mph
Vehicle
62 mph
CONTROL

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ATG Infrastructure

Our mission is to provide high quality, reliable infrastructure to ATG developers. We maintain infrastructure that is unique to ATG, and leverage our core business partnership for platforms that are advantageous to ATG needs.

ATG Infra Team

Cloud Infrastructure

Jerry Xie
CJ Ketchum
Joshua Goller
Roberto Badillo
Jeff Herald
Josh Hansen

Compute Infrastructure

Steve Harris
Chris Riley
Adam Backer
Davy Ho
Clement Buisson
Eugen Feller

Data Infrastructure

Mingjie La
Tracy Carley
Zac Baranzini

Data Center Infrastructure

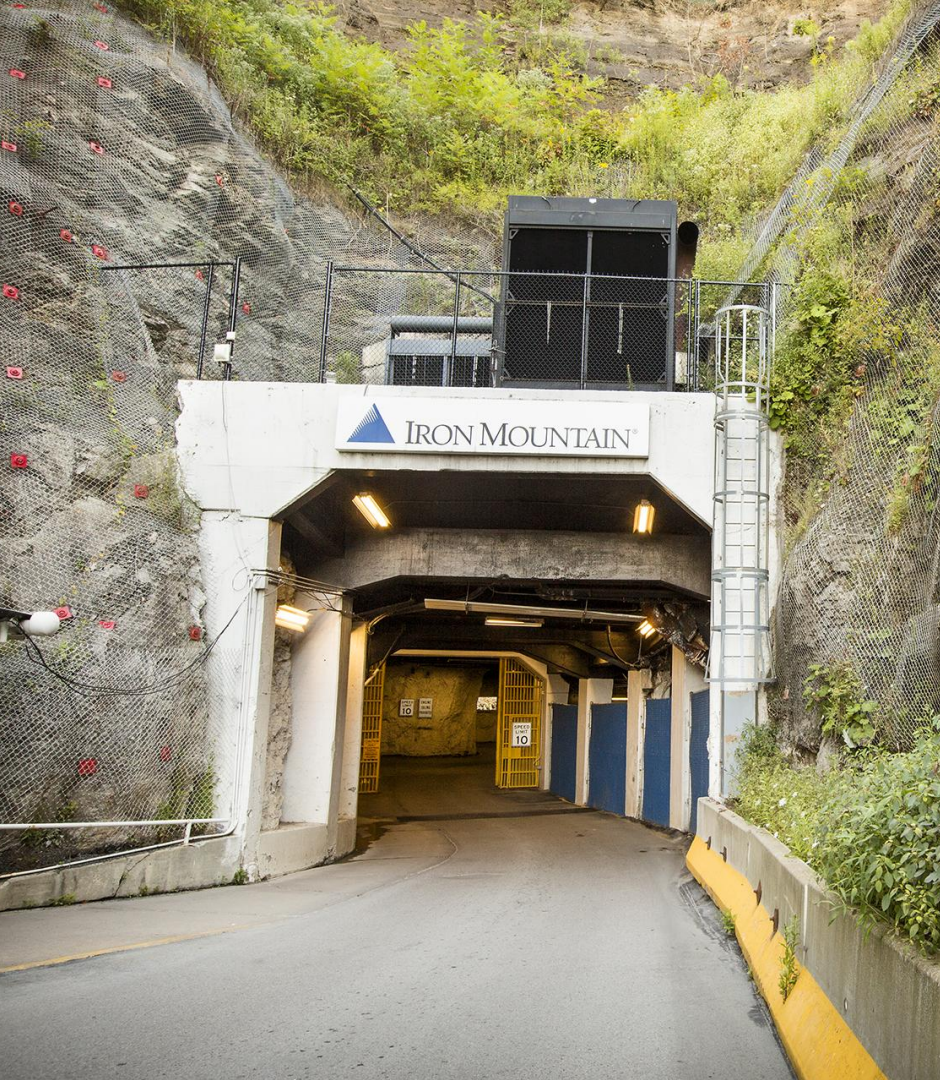
Nahum Shalman
Vijit Jain
Mitch Usher
Michael Schuett

Storage Infrastructure

Jerry Xie (EM)
Judah Okeleye
Jinshan Xiong
Martin Velez

Other

Nick Cobb, Engineering Manager
Megan Macleod, Technical Program Manager


IRON MOUNTAIN

Tools


aws
Jenkins
C++
git
JS
HashiCorp
Terraform
golang
Spinnaker
python
puppet
FreeNAS
JFrog Artifactory
HashiCorp
Packer
React
GCC
node
JS
PostgreSQL
Linux
intel
docker

Storage

Log Everything!

Store Logs

Offload Server

Lustre®
(Petabytes)

Use logs to train car.

Use logs to replay trip.

Clients

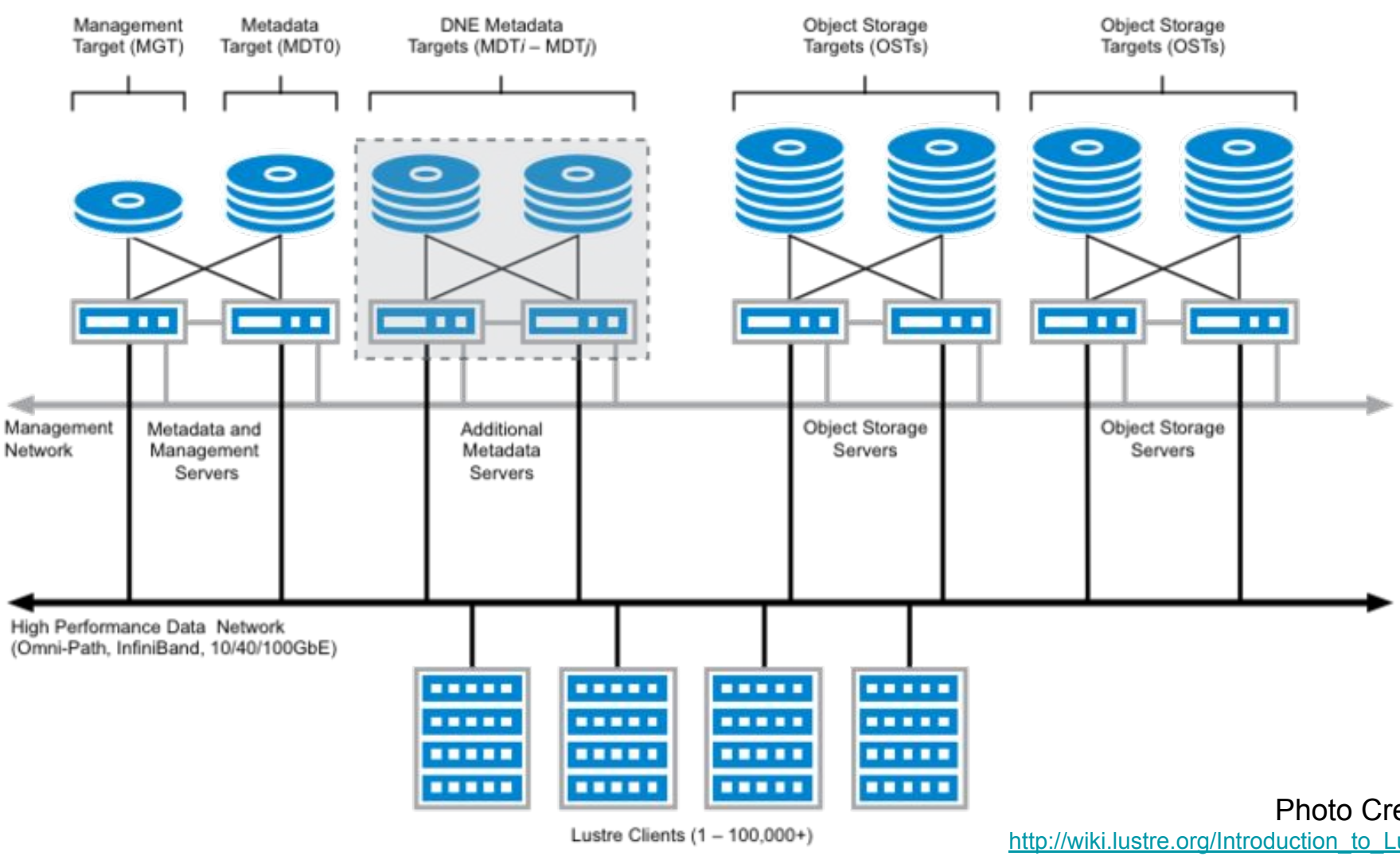


Photo Credit:
http://wiki.lustre.org/Introduction_to_Lustre

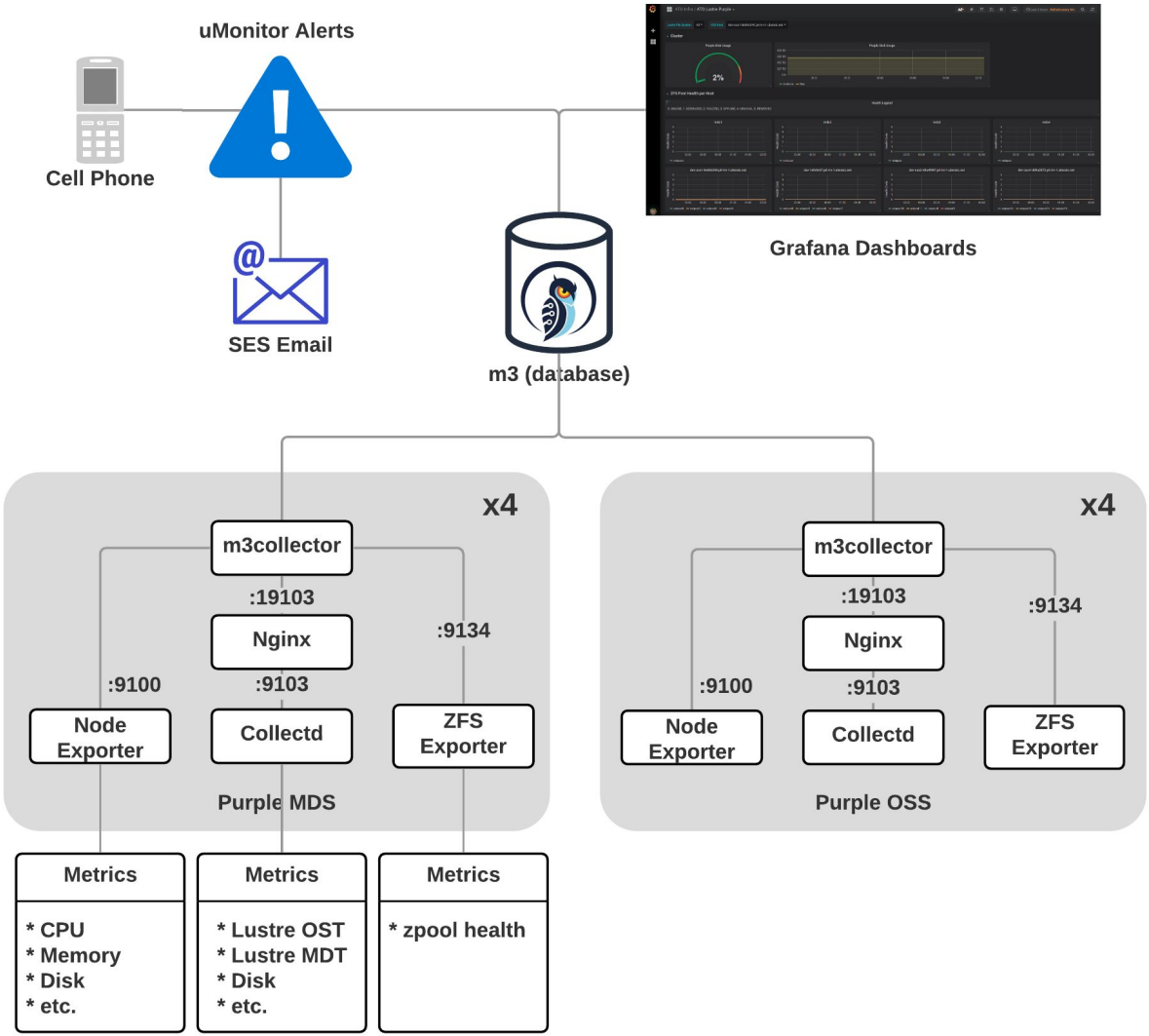


Photo Credit:
Martin Velez

AWS Core Infrastructure and Services

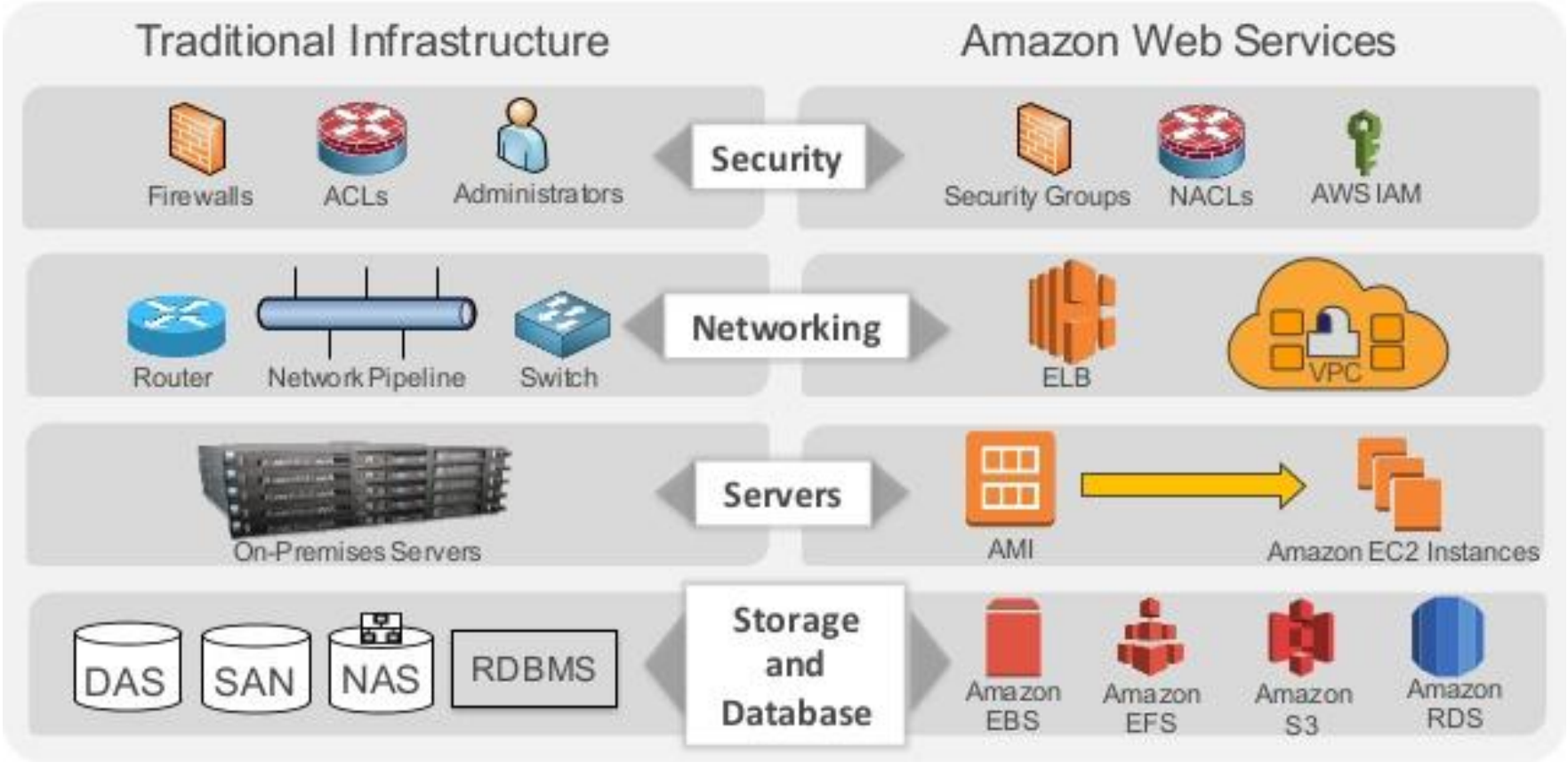


Photo Credit: https://www.slideshare.net/AmazonWebServices/bootcamp-getting-started-on-aws/9

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Everyone is a
on different
journey.

I am an Immigrant

Born: Guadalajara, Jalisco, MEXICO

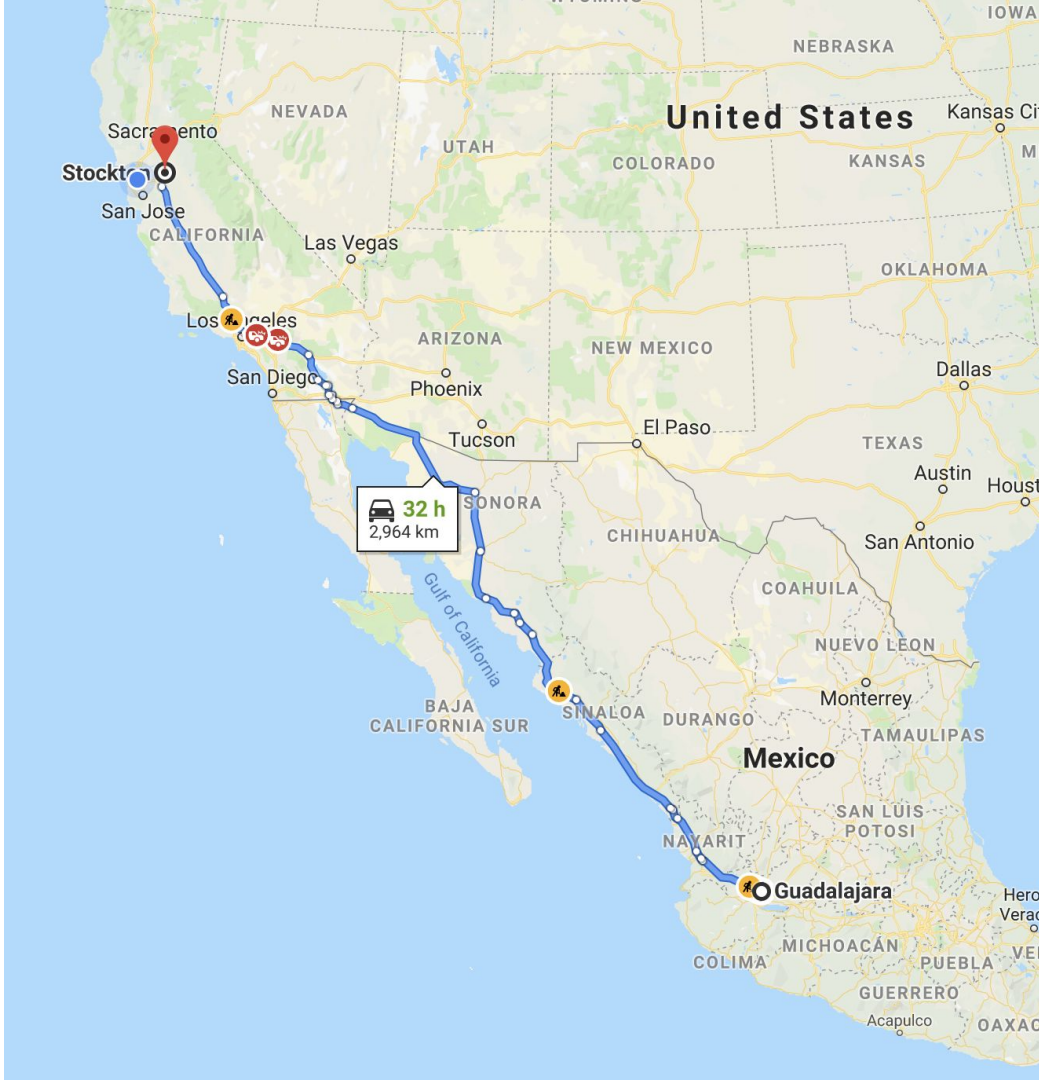
Raised: Stockton, CA USA

Have Lived In: Davis, CA

Have Lived In: Sacramento, CA

Currently Live In: San Leandro, CA

Currently Work In: San Francisco, CA



Life before Uber

USA

- Selling Fruits and Vegetables
- Painter
- Pest Control/Janitor
- Fast Food
- Cook
- Carpenter

Mexico

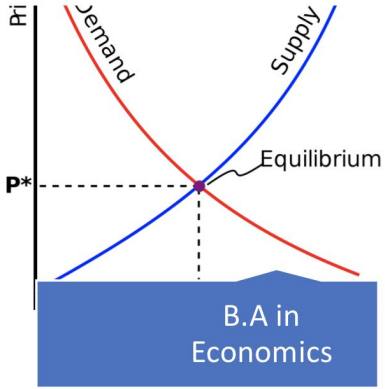
- Cook
- Call Center Rep/Supervisor/Manager

USA

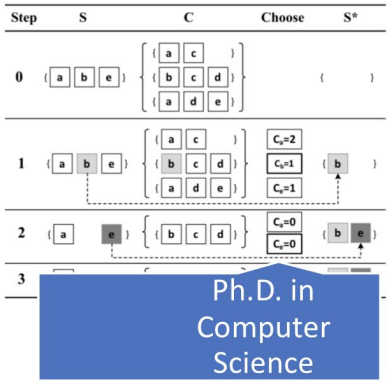
- Call Center Rep (Bank)
- Book Seller
- Research Assistant/Coordinator
- Software Engineer
- Graduate Student Rearcher
- Teaching Assistant

Education

2010



2018



UC DAVIS
UNIVERSITY OF CALIFORNIA

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Mexico
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Build Systems

Build websites.

Build command line applications.

Build mobile applications.

Use different programming languages and tools.

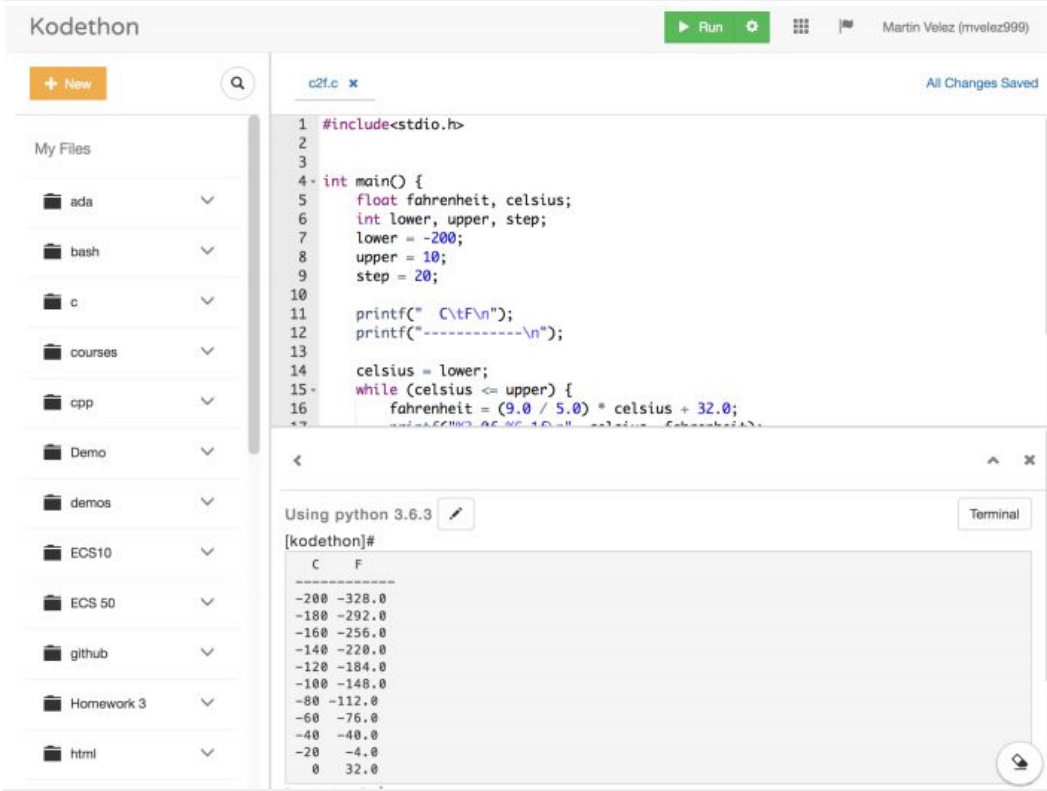

Photo Credit:
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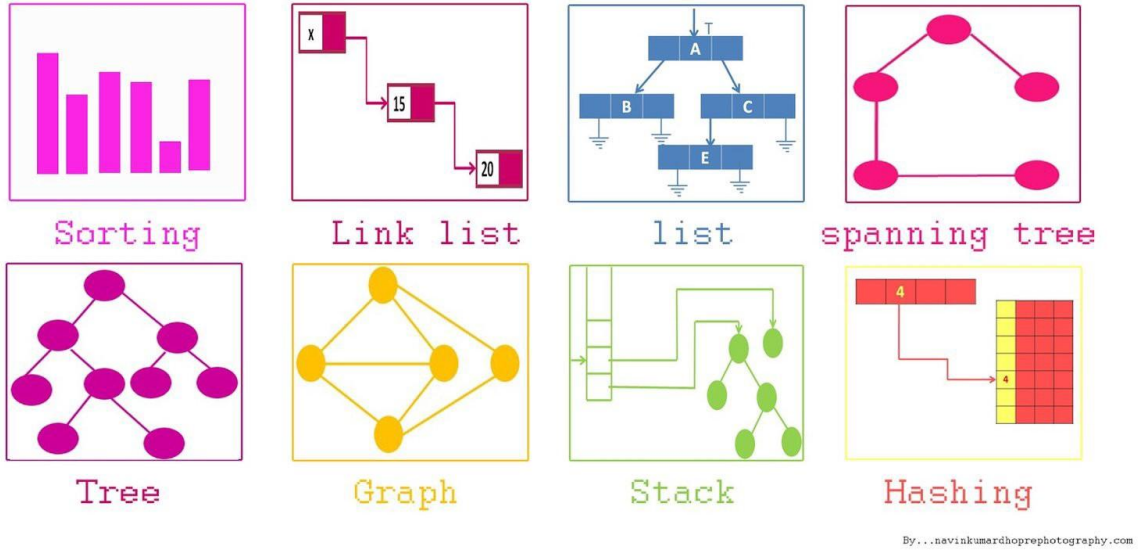

Master the Basics

You are introduced to algorithms and data structures in college.

Practice on your own.

Try LeetCode and HackerRank.

Do 100s of exercises.

Photo Credit:
https://medium.freecodecamp.org/how-to-improve-your-data-structures-algorithms-and-problem-solving-skills-af50971cba60

Focus on Collaboration

Ten people can lift a piano easier than one person alone.

Work in teams to build more complex systems.

Keep note of what worked, and what you could do better.

Interviewers do assess how well you communicate, and how well you would fit into our teams.

Thank You

martin.velez@uber.com

Come to our booth!