AWS re:Invent

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CMP316

Scalable autonomous vehicle simulations with AWS Batch

Vijitha Chekuri (she/her)
Global Autonomous Business Development Leader
AWS

Abdi Ibrahim (he/him)
Principal Solutions Architect
AWS

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Agenda

I. Introduction

II. Overview – autonomous vehicle (AV) development workflow

III. AV architectural patterns

IV. Simulations overview and compute requirements

V. Whiteboarding Q&A

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How many miles do we need to drive?

How many miles of testing would be required for AVs to demonstrate the equivalent of the 2013 US human fatality rate?

a) 10 million
b) 125 million
c) 275 million
d) 555 million
e) 1.4 billion

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How much time would it take with a fleet of 100 AVs being test-driven 24 hours a day, 365 days a year, at an average speed of 25 miles per hour?

a) 1 year
b) 7.5 years
c) 12.5 years
d) 20 years
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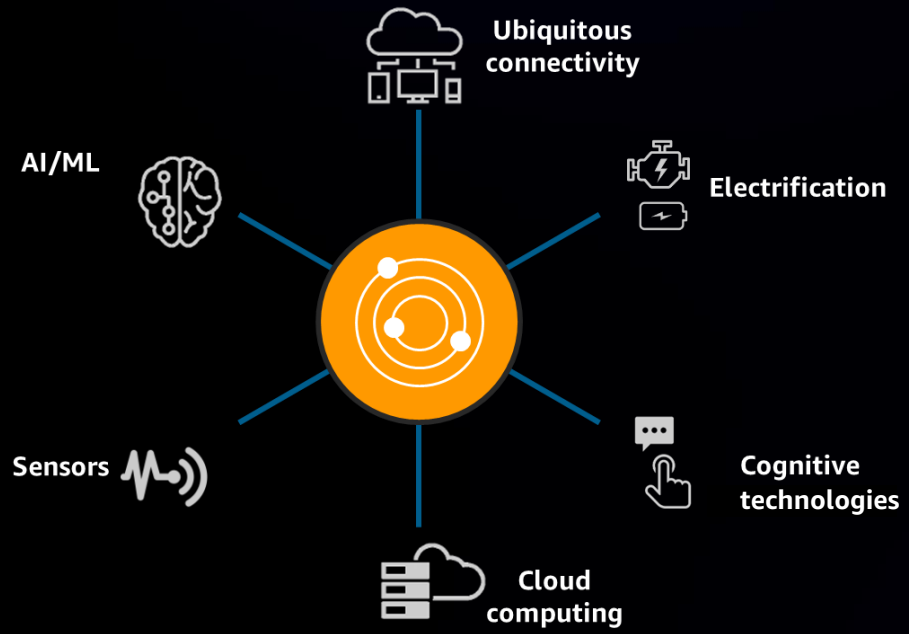
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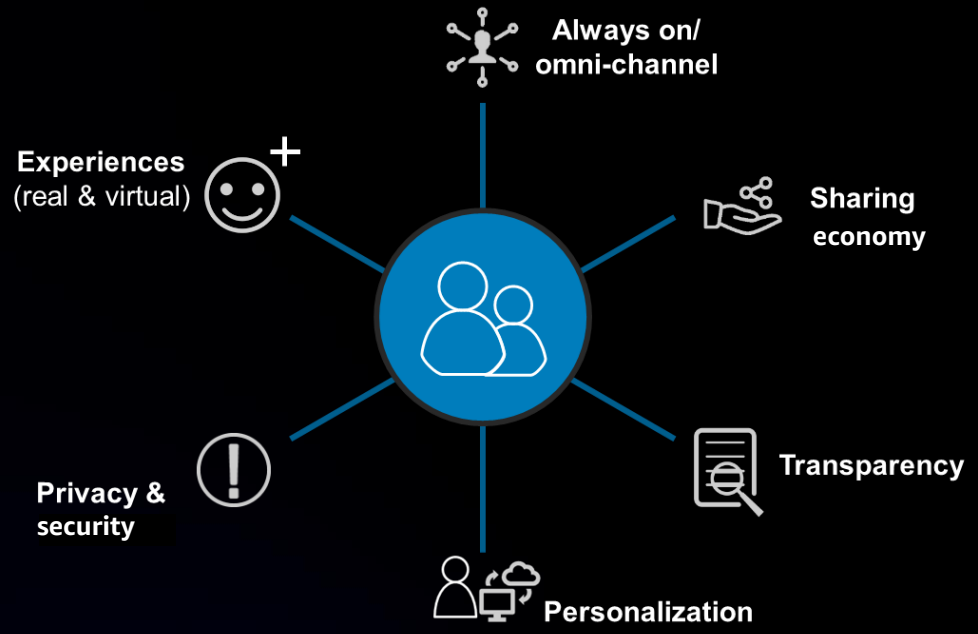
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Automotive industry

UNPRECEDENTED CONVERGENCE OF TECHNOLOGY AND CONSUMER TRENDS

Transformational technology ⟷ Consumer trends





Connected Autonomous Shared Electrification

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Road to AVs

Near term (2021)

ADAS focus for OEMs and R&D phase for AVs

Medium term (2022–2025)

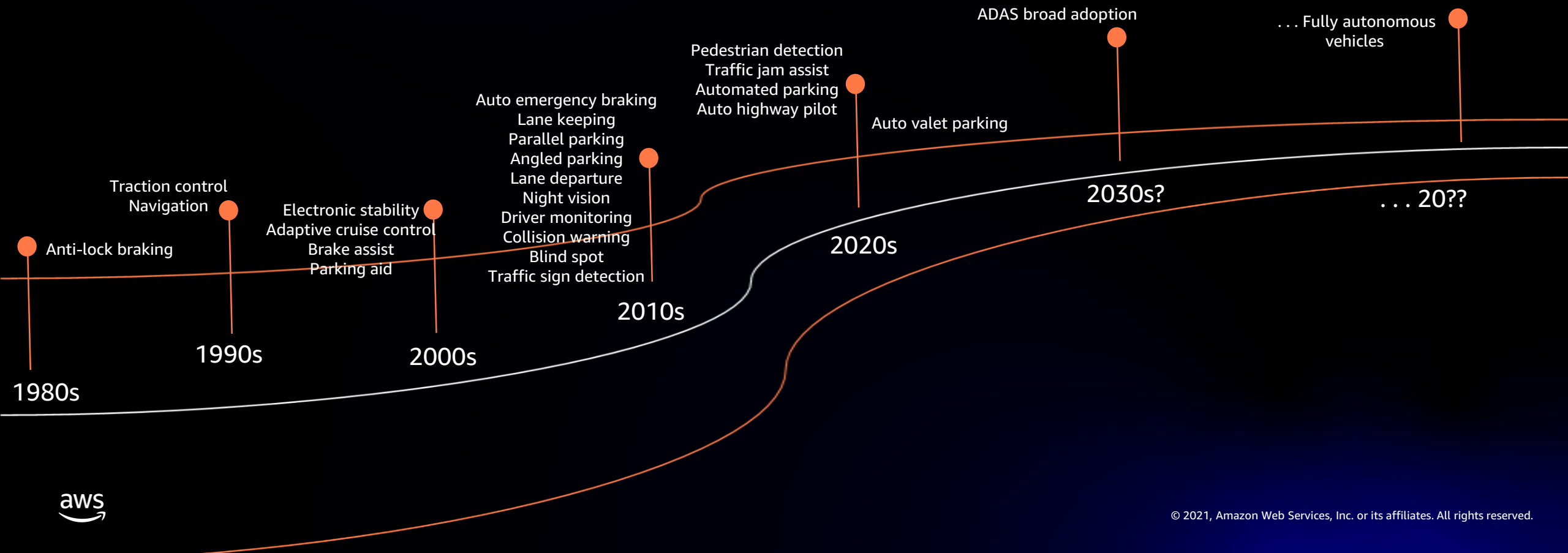
First AV use cases in delivery and limited ODD applications

Long term (2025+)

Commercial scale of AVs transforms transportation

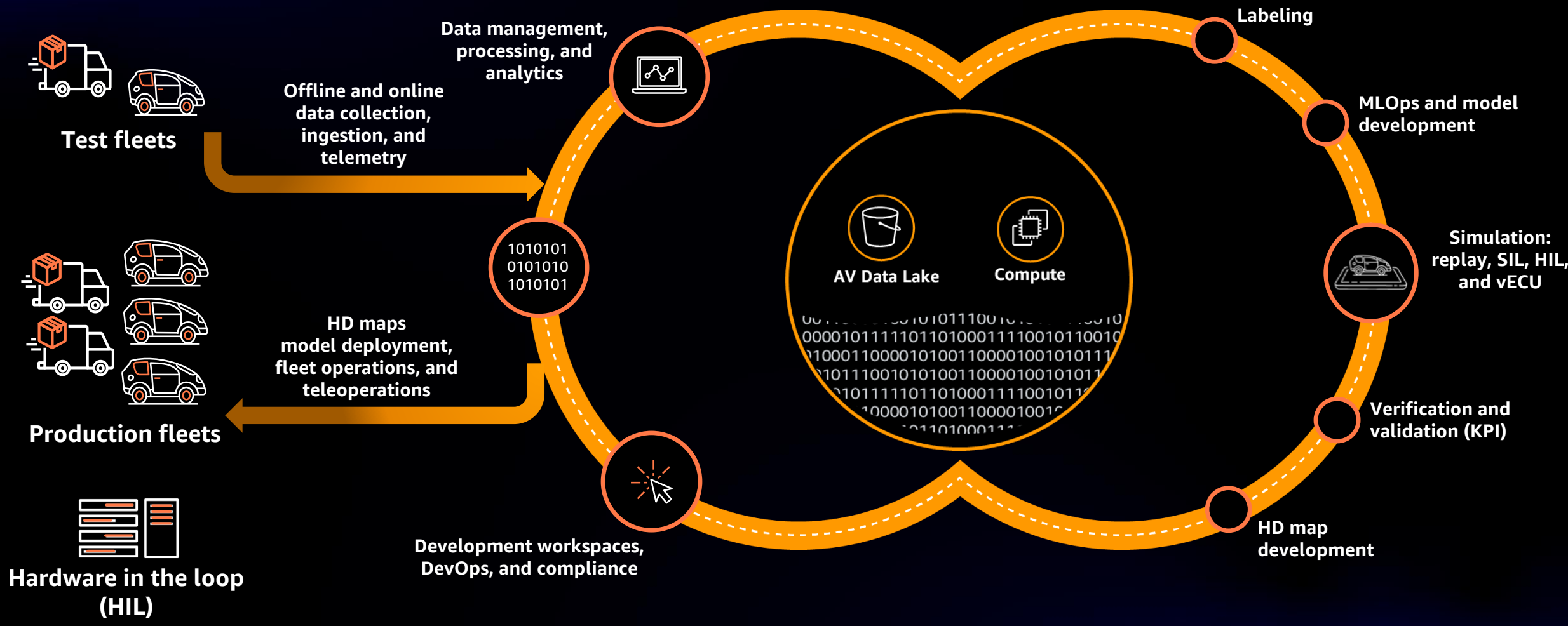
AV simulation

An accelerator factor



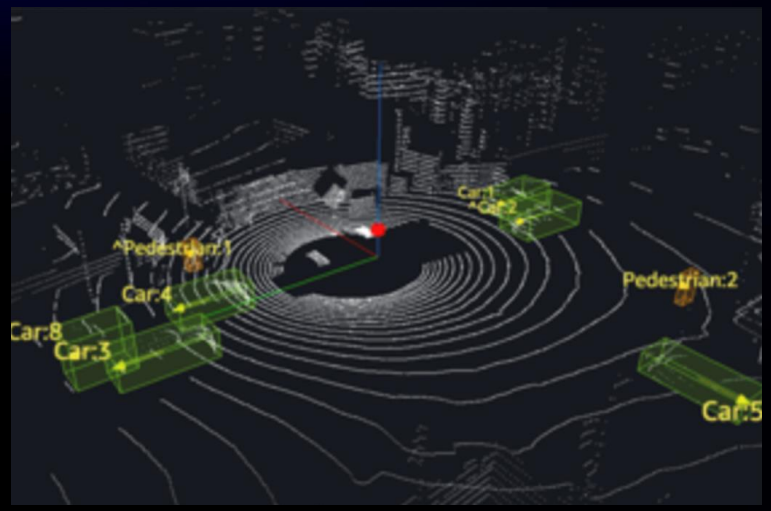
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AV development workflow

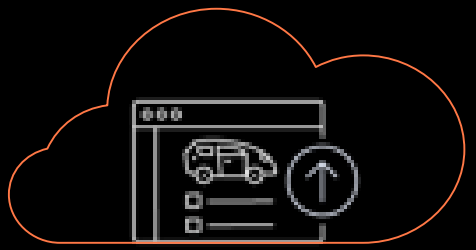


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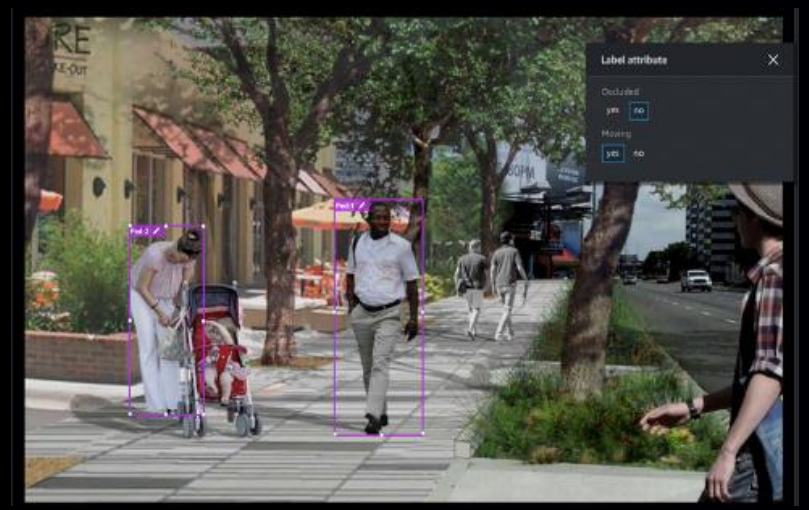
AV/ADAS test vehicle challenges



I. Benefits of road test data:
   I. Validation of the entire vehicle sensor stack
   II. Real-world and realistic test
   III. Handles most of well-understood behavior



Simulation in cloud

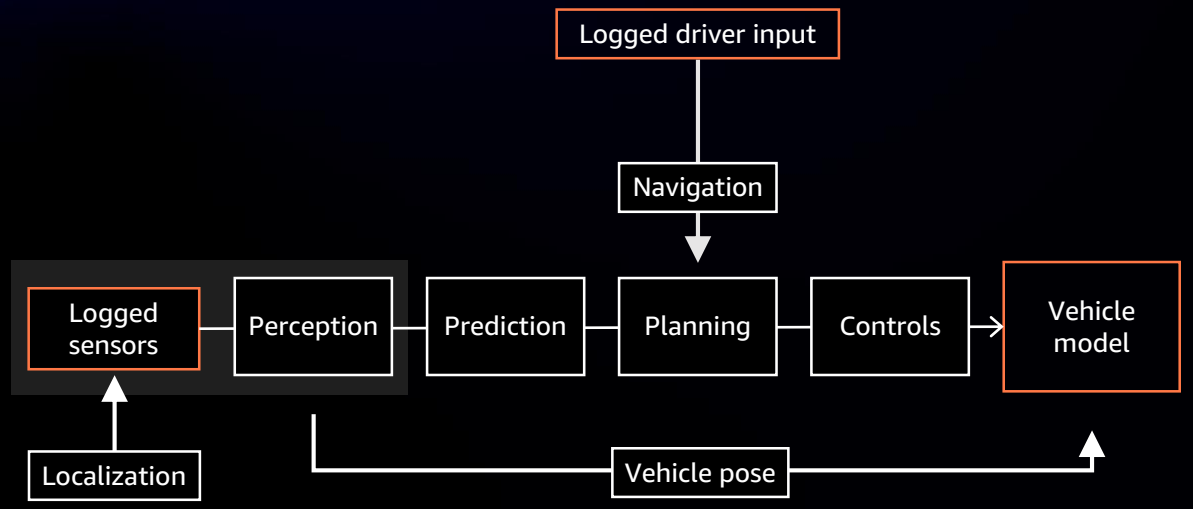


I. Challenges with street driving:
   I. Not always effective
   II. Lack of measurement (calibration, logger issue)
   III. May be dangerous and risky
   IV. Hard to target non-exercised conditions
   V. Not effective for rare and unknown conditions
   VI. High cost

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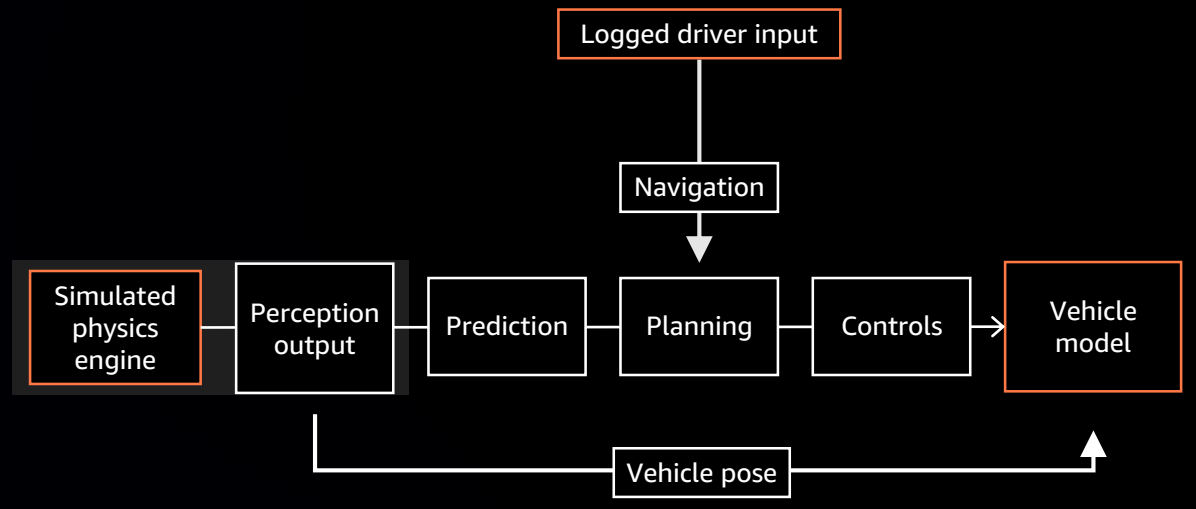
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Types of AV simulations



Log/replay simulations

Replay recorded sensor data to the driving stack and evaluate how it reacts



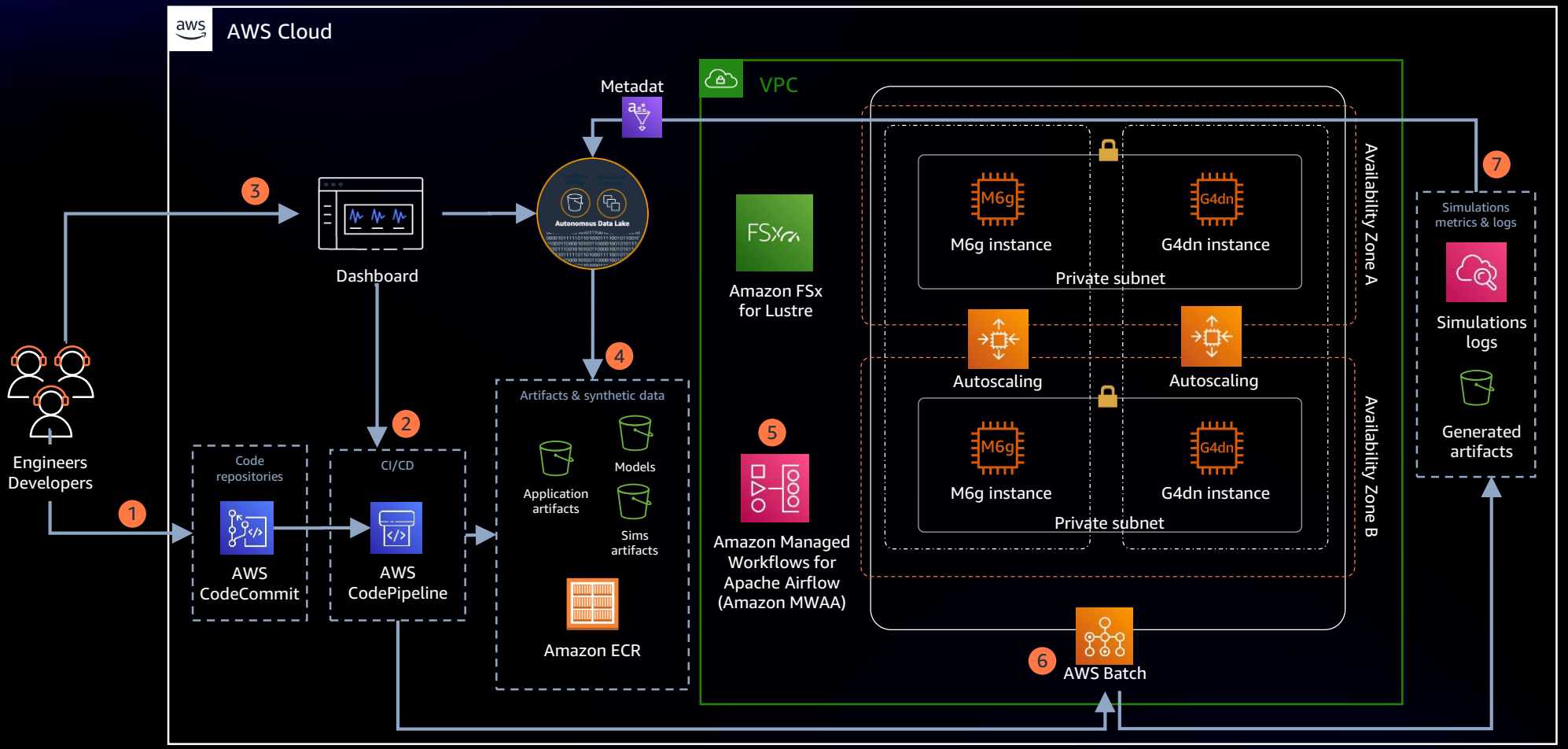
Virtual/driving simulations

Evaluate scenarios and variants in a simulated world

Sensor data is sent to the driving stack, which carries driving commands

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Simulations with AWS Batch



1. Test engineers and AV/ADAS function developers create test cases and simulation scenarios, and commit to version-controlled code repository system (AWS CodeCommit).
2. AWS CodePipeline is triggered by AWS CodeCommit and compiles simulated environment. Application is containerized and stored on Amazon ECR. Simulation scenarios, parameterized vehicle sensors, and input data are stored in S3 buckets.
3. Engineers and developers can consult the status of the pipeline and ongoing simulations workflows on the dashboard. They can define and trigger particular scenarios or scenario sets, test plans, and workflows, and monitor them. Data is pulled from the data lake.
4. Simulation models and artifacts are pulled from or moved to archive depending on usage frequency.
5. Workflows are triggered via user interaction on the dashboard, automatically through the Amazon MWAA, or played at intervals.
6. AV simulations are executed as a job in container using AWS Batch. CPU or GPU instances are auto-scaled based on queue sizes.
7. Simulations results and artifacts are gathered in S3 buckets and logged in Amazon CloudWatch, and then incorporated in the data lake so users can use them.

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Amazon EC2 instances for AV simulations

NEW

	G4dn	P3	P3dn	P4d	G5
Ideal for	Accelerated training of small to medium models with less than 100M parameters	Training medium to large models with 100M to 300M parameters Good for single-node distributed training	Training large models with more than 300M parameters May offer better price/performance than P4D due to Spot availability Good for multi-node distributed training	Customer looking for best training performance on the cloud Training large models with more than 300M parameters EC2 UltraCluster support great for multi-node distributed training	Accelerated training of small to large models on the cloud Single-node training of simple to moderately complex models
Key features	16 GB/GPU PCIe only 25–50 Gbps networking and 100 Gbps on bare-metal	16 GB/GPU 200–300 GB/s NVLink (4, 8 GPUs) 10–25 Gbps networking	32 GB/GPU 300 GB/s NVLink (8 GPUs) 100 Gbps networking (EFA)	40 GB/GPU 600 GB/s NVLink (8 GPUs) 400 Gbps networking (GPUDirect RDMA over EFA)	24 GB/GPU PCIe only 10–100 Gbps networking
Acc. config	1, 4, or 8 NVIDIA Tesla T4s	1, 4, or 8 NVIDIA Tesla V100s	8 NVIDIA Tesla V100s	8 NVIDIA Tesla A100s (latest)	1, 4 or 8 NVIDIA Ampere A10Gs

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Thank you!

Vijitha Chekuri
vijithc@amazon.com

Abdi Ibrahim
ibrabdil@amazon.com

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