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AUT303

Reimagining mobility with Toyota Connected

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Toyota Connected journey

Vision

Challenges, key steps, and decisions

Outcomes achieved

An interesting software engineering challenge

A peek into the future



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“It's my goal to transition Toyota from an automobile company to a mobility company, and the possibilities of what we can build—in my mind—are endless.”
Akio Toyoda at CES, 2018



TOYOTA
connected

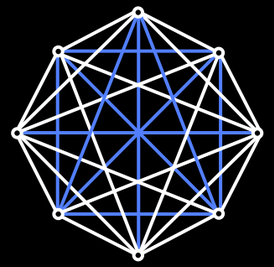
OUR MISSION

Free us from the tyranny of technology, making a connected life a more human experience

Focusing on four key pillars



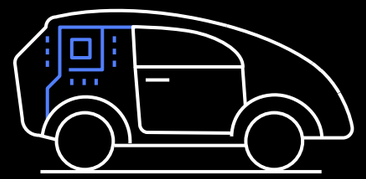
Customer experience



Platforms and enabling technologies



Safety and security



Convenience and access

PRIVACY BY DESIGN

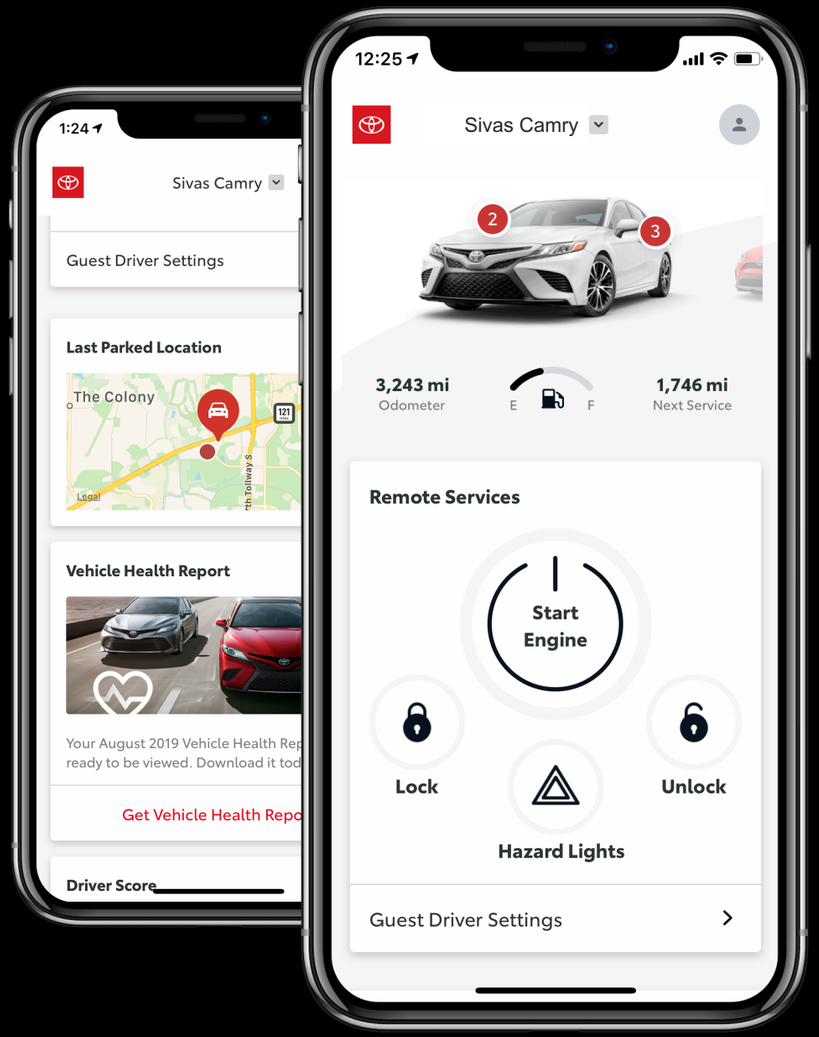
Use customer data with customers' consent to make every experience in a Toyota vehicle personal and memorable



REAL-TIME

MILLIONS

of data points from connected vehicles globally



SINGLE PLATFORM

to support all regions

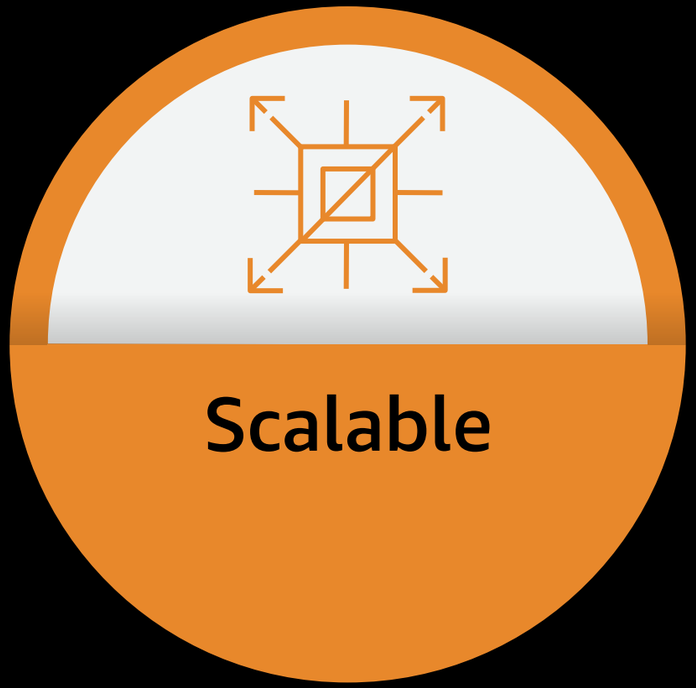
Build Connected Vehicles' Global Mobility Services Platform to enable providing safety, security, and convenience services to our customers at scale

Challenges, key steps, and decisions



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Challenges



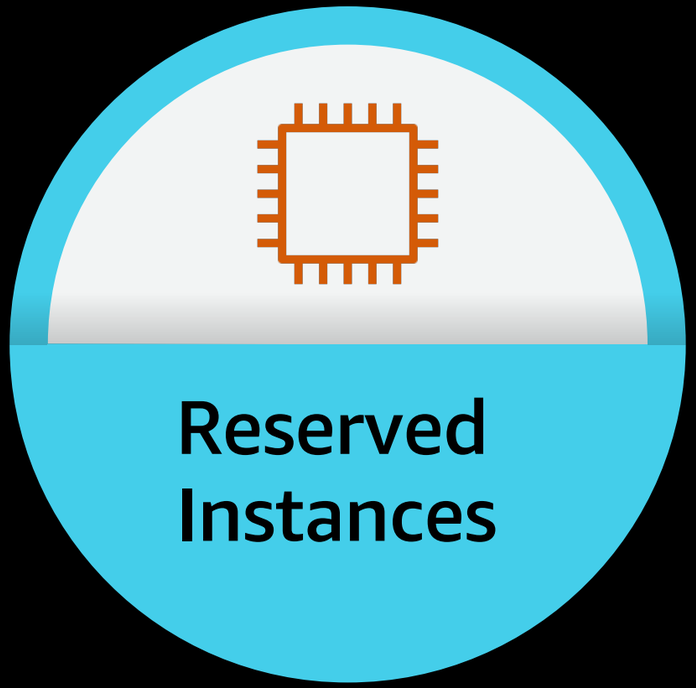


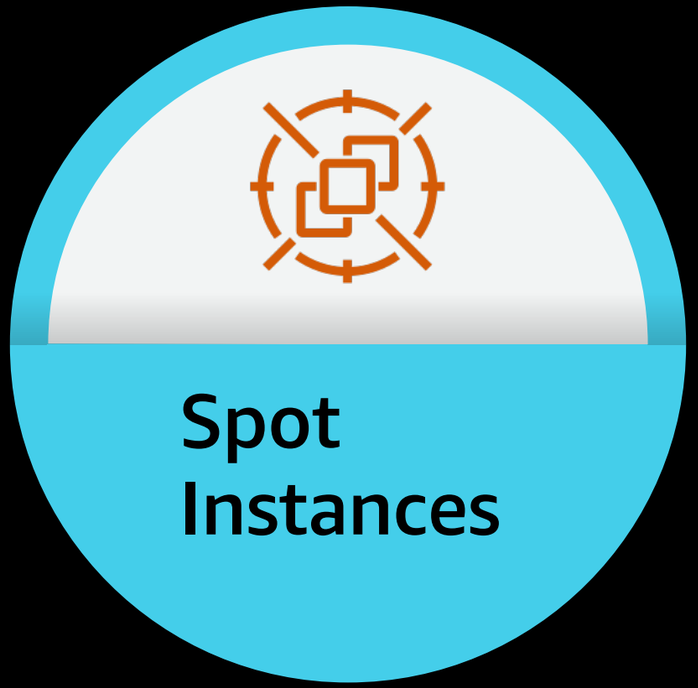


Every message transmitted from a vehicle must have a **purpose**, provide quantifiable customer **value**, and be processed if and only when it is **needed**.



Decisions





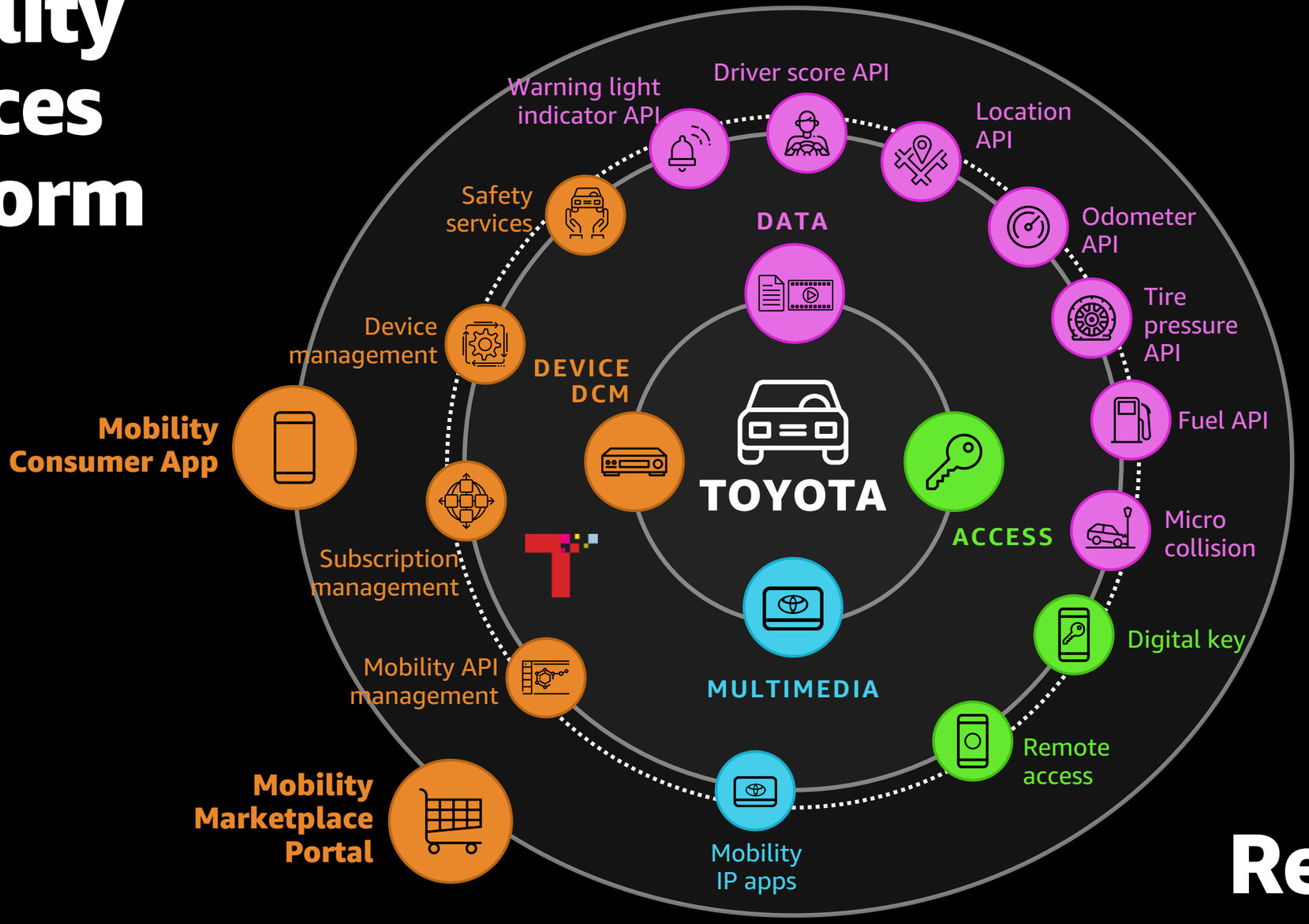


Outcomes achieved



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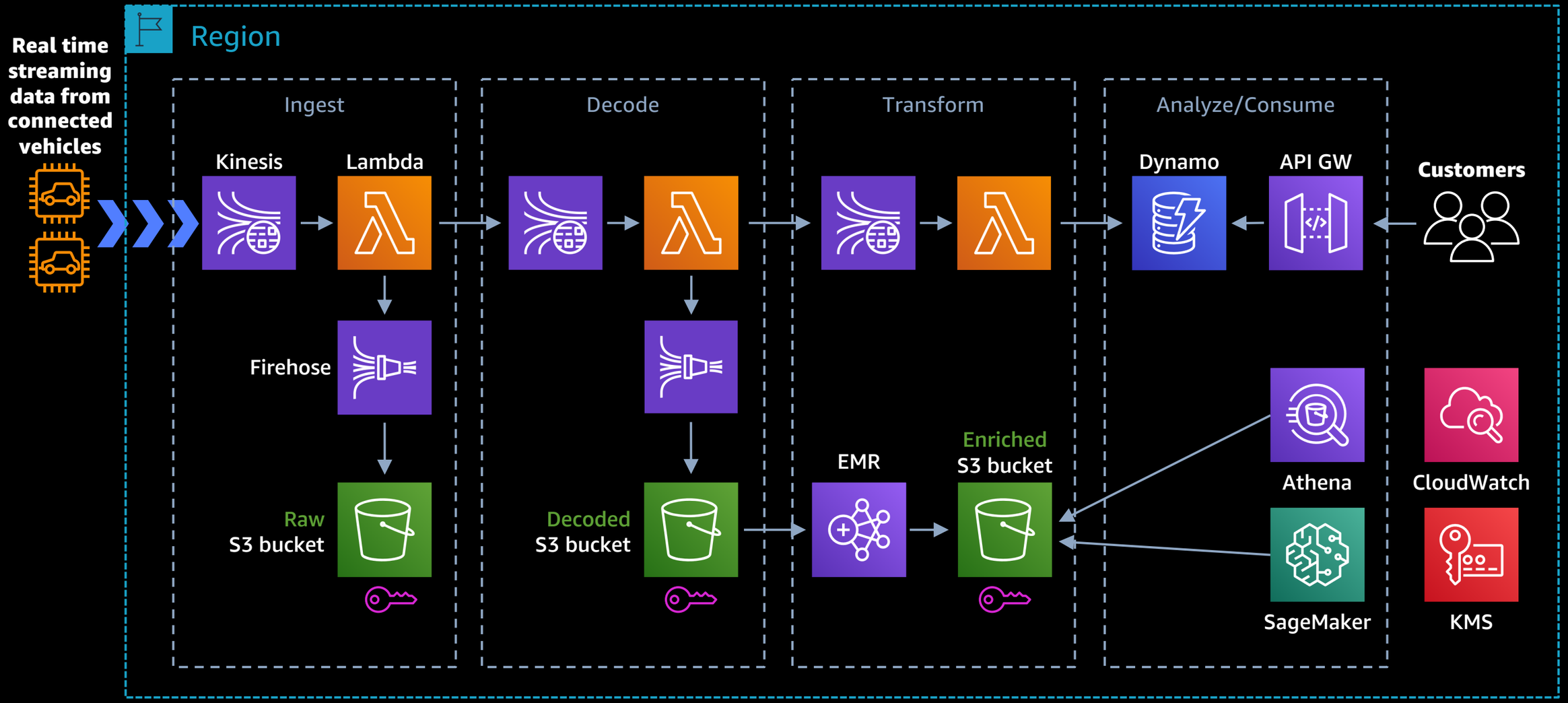
Mobility services platform



API management

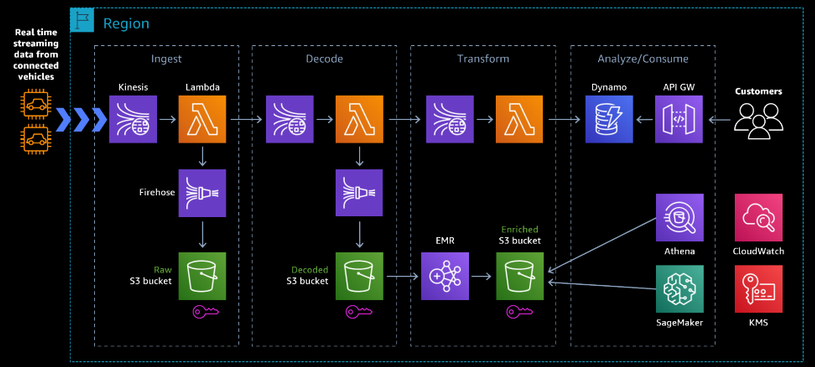
Reimagining mobility

Data lake architecture



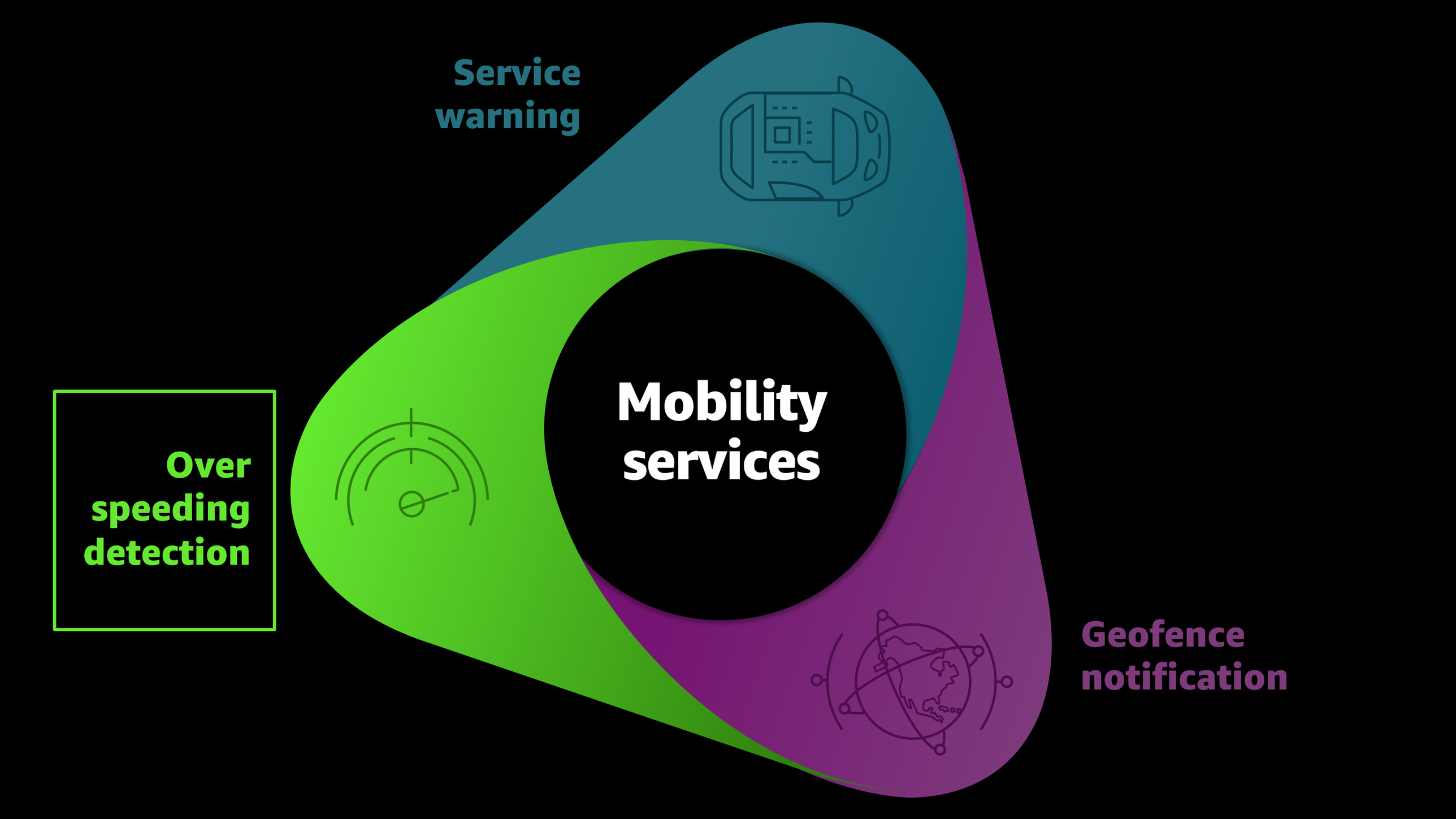
Toyota connected data lake

Data lake



Key highlights

- Serverless, scalable architecture
- Amazon S3 data lake, infinite capacity, scalable pattern, lifecycle policies
- Optimized parquet data sets for analytics by vehicle and model
- Spot Instances for EMR jobs
- DynamoDB TTL for cost management
- 30x cost reduction
- 40x reduction in processing time of aggregation jobs (60hrs→1.5hrs)
- Highly available platform
- Products to enhance safety and improve customer experience


Service warning
Mobility services
Over speeding detection
Geofence notification

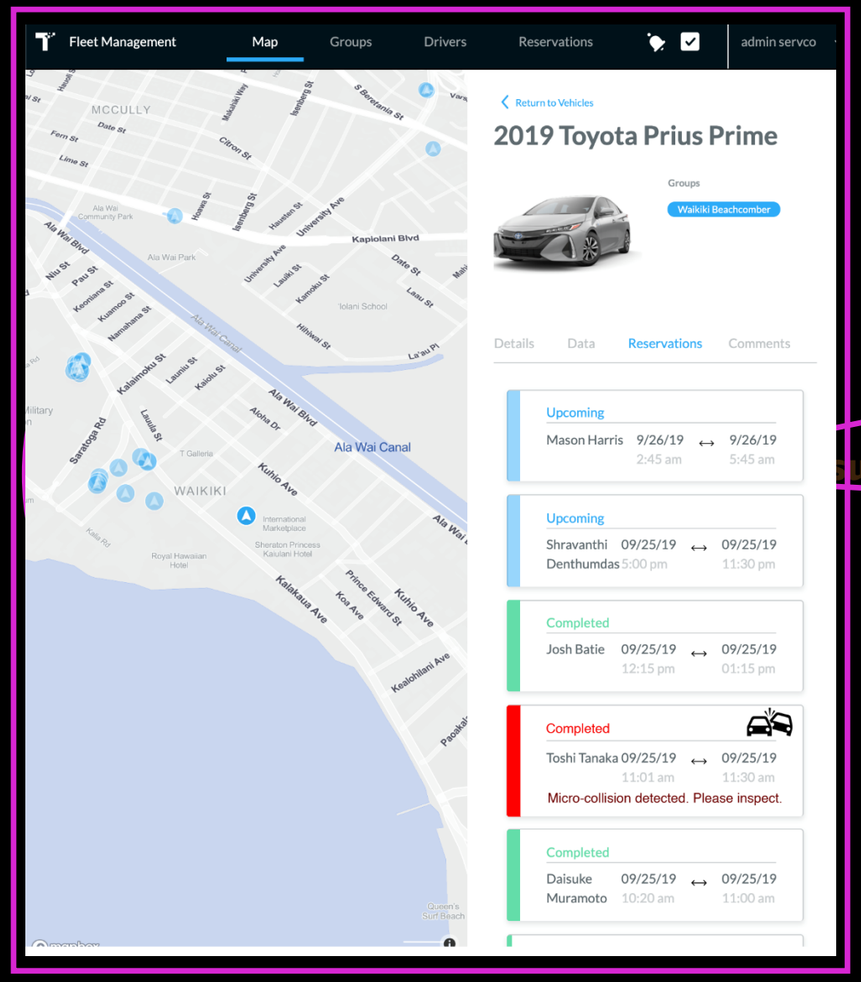
An interesting software engineering challenge

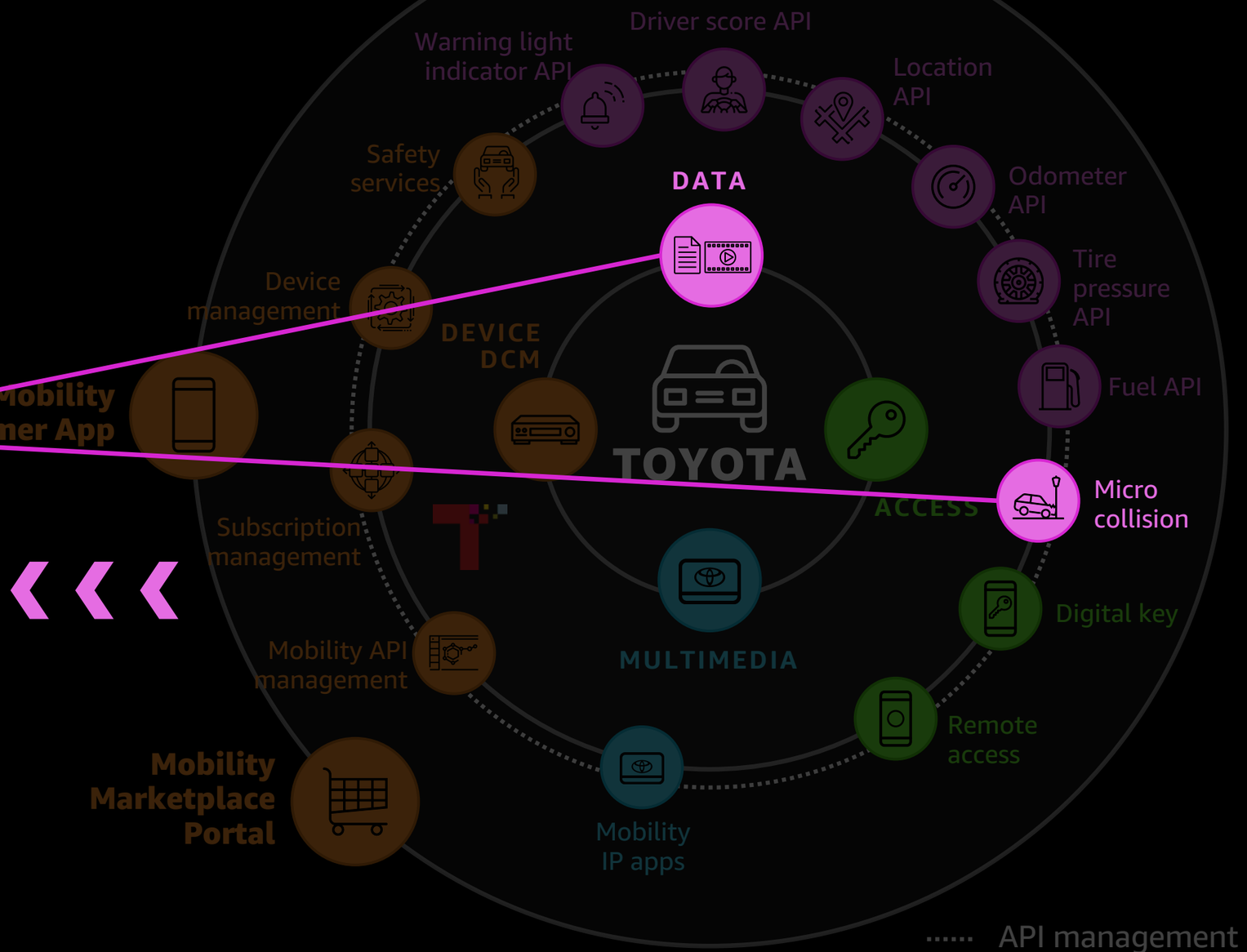


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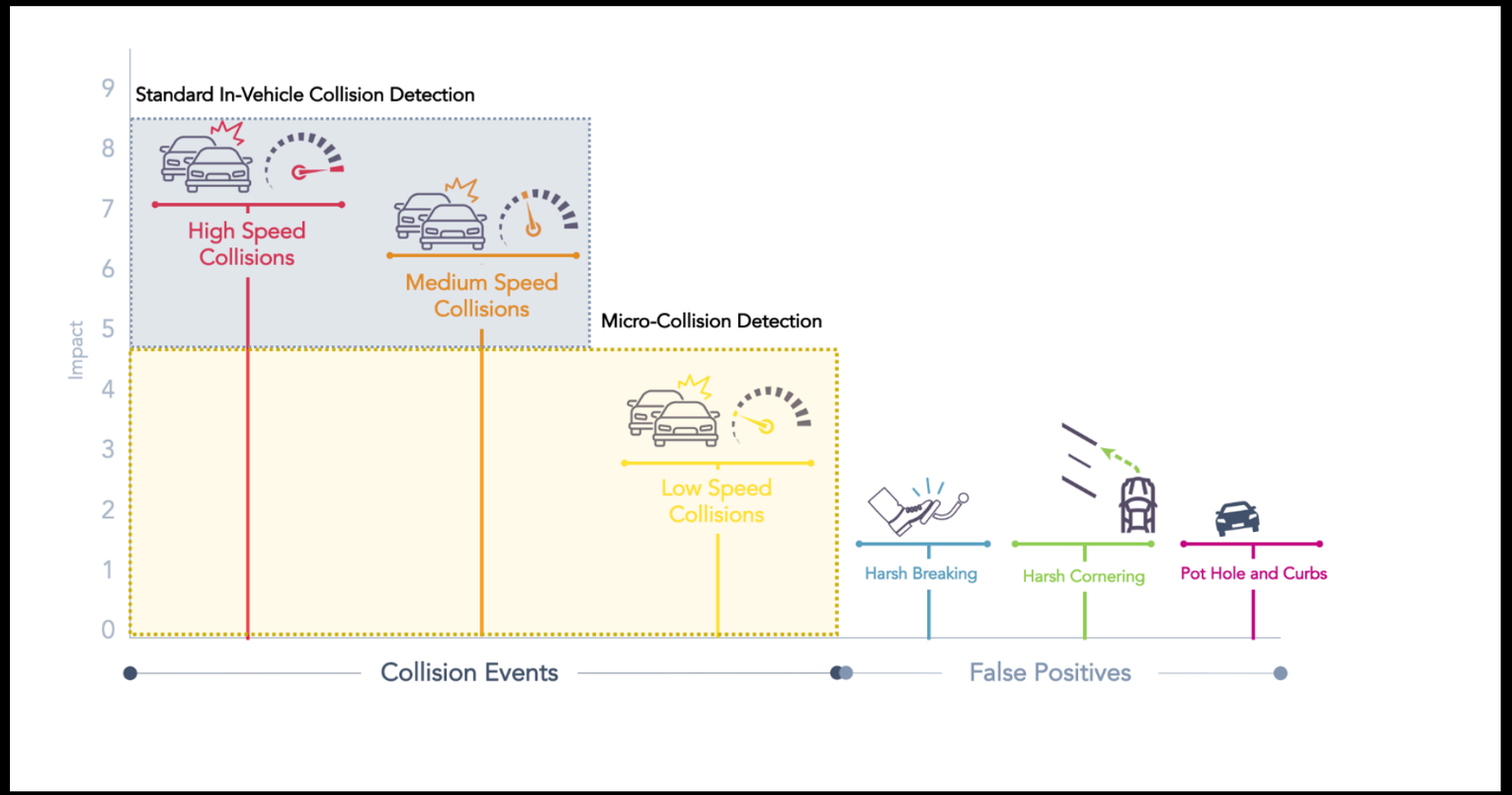
Micro-collision detection





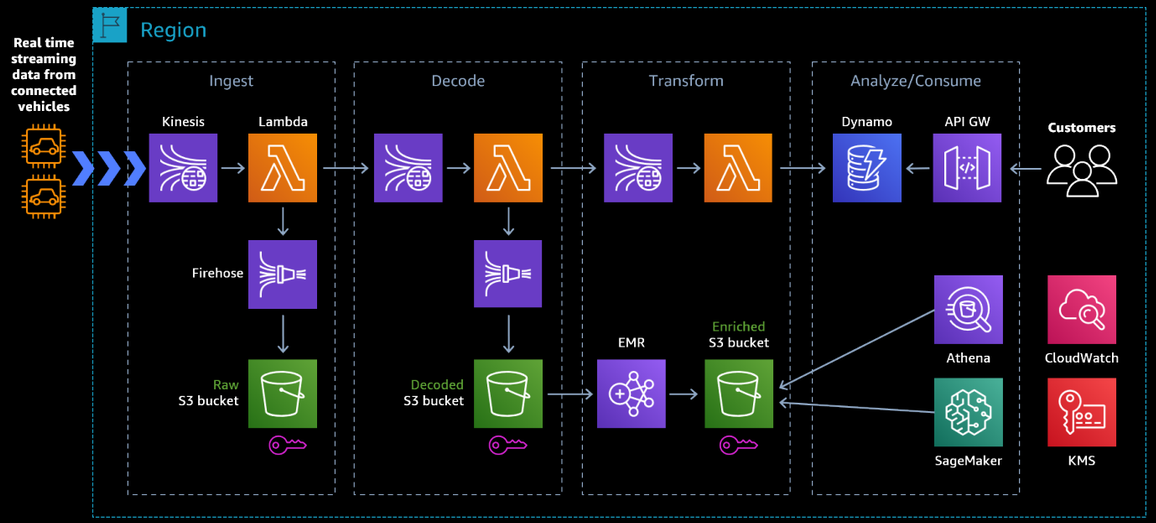
Challenge

Capturing collisions for all speed categories (as shown), while eliminating any false positive cases



Micro-collision

OPTION A



- Leverage the existing data lake
- Run large queries using Amazon Athena against Amazon S3 data lake

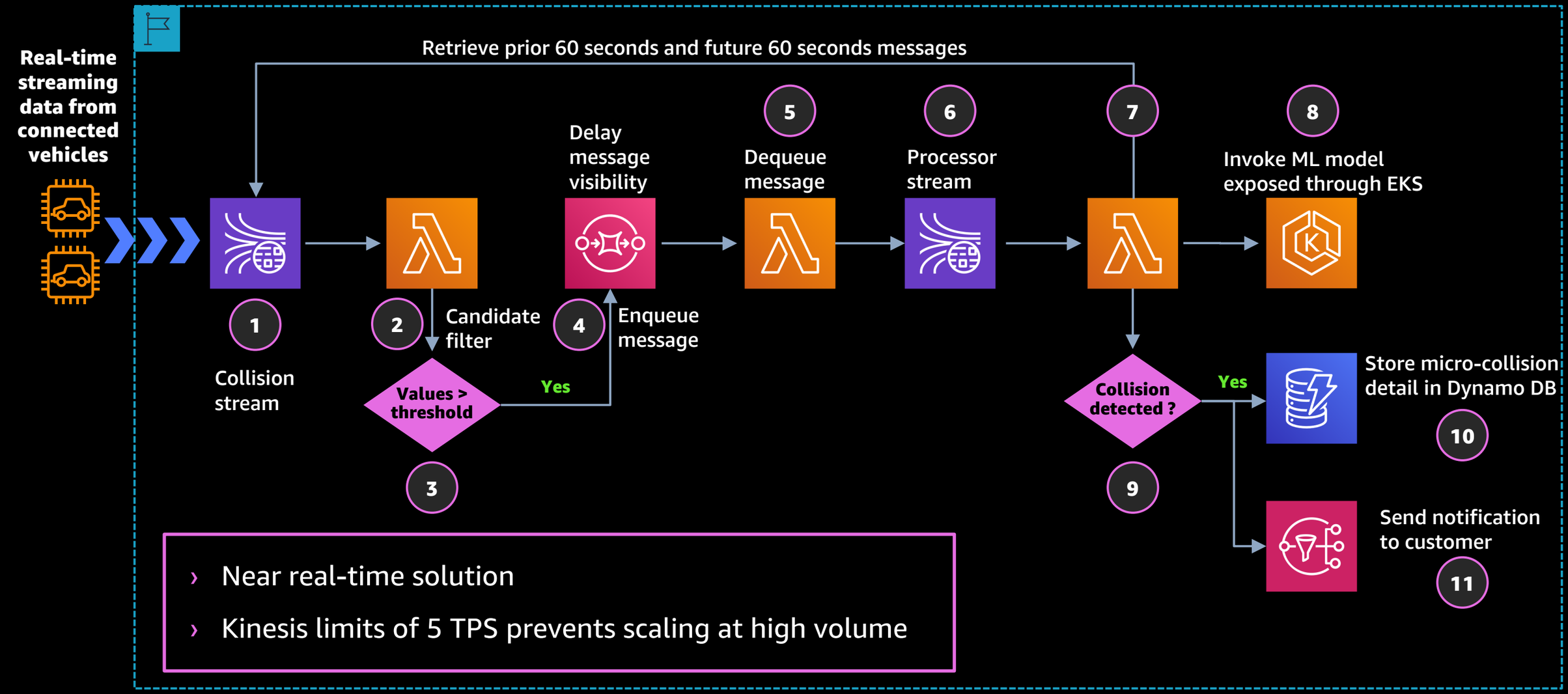
Cons: after the fact, time consuming, not providing value

- Create indexed database tables in Amazon DynamoDB
- Frequent lookups to piece together data

Cons: expensive solution

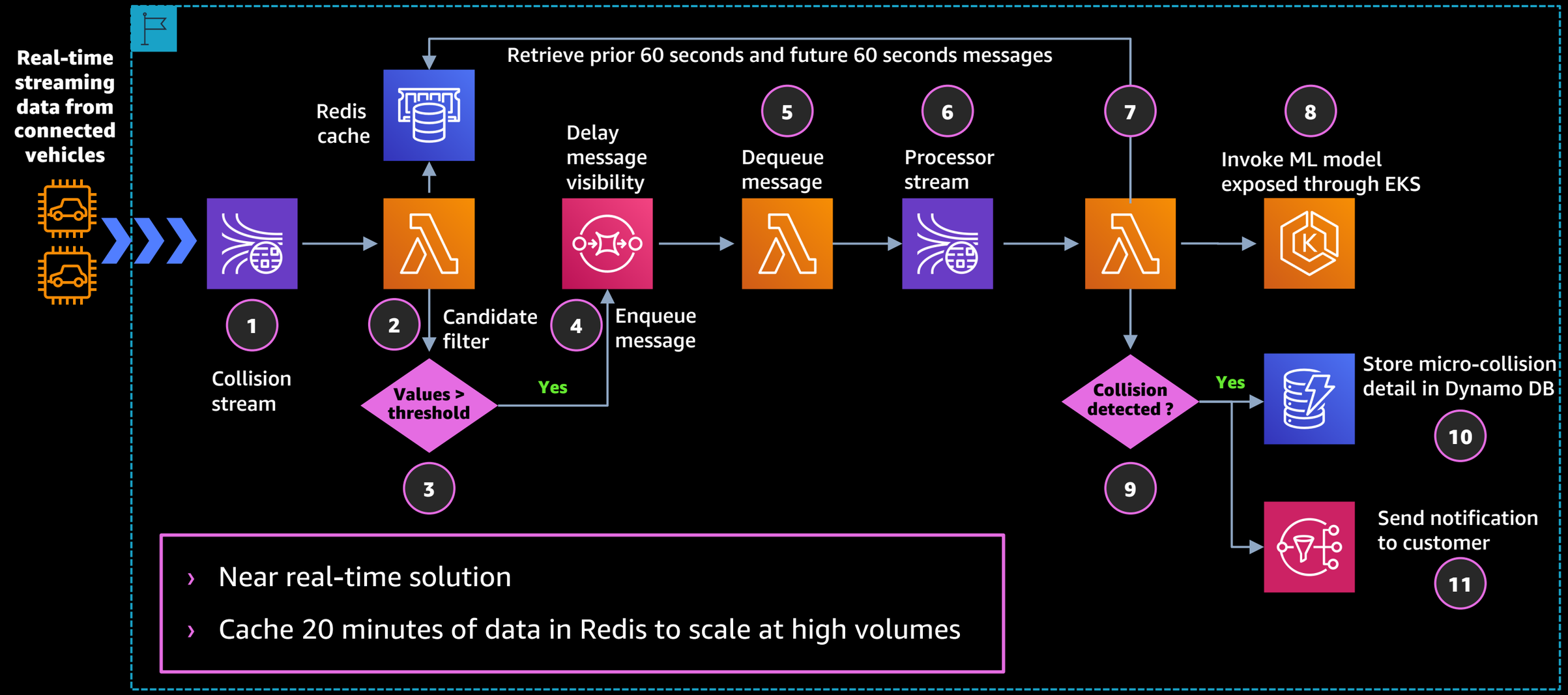
Micro-collision

OPTION B



Micro-collision

OPTION C





ElastiCache
for Redis

Scalability:

› Add or remove shards
› Data partitioning across shards
› Online re-sharding with no noticeable performance hit

“zadd” to add elements to a sorted set

```
RedisCluster.zadd(VIN(byte[]), Timestamp, Message(byte[]));
```

“expire” to set an expiry time for an element added to cache

```
RedisCluster.expire(VIN(byte[]), ExpirationTime);
```

“zrangeByScore” to retrieve elements for a score between min and max

```
RedisCluster.zrangeByScore(VIN(byte[]), timeMin, timeMax));
```

“zremrangeByScore” to remove elements between mix and max

```
RedisCluster.zremrangeByScore(VIN(byte[]), timeMin, timeMax));
```

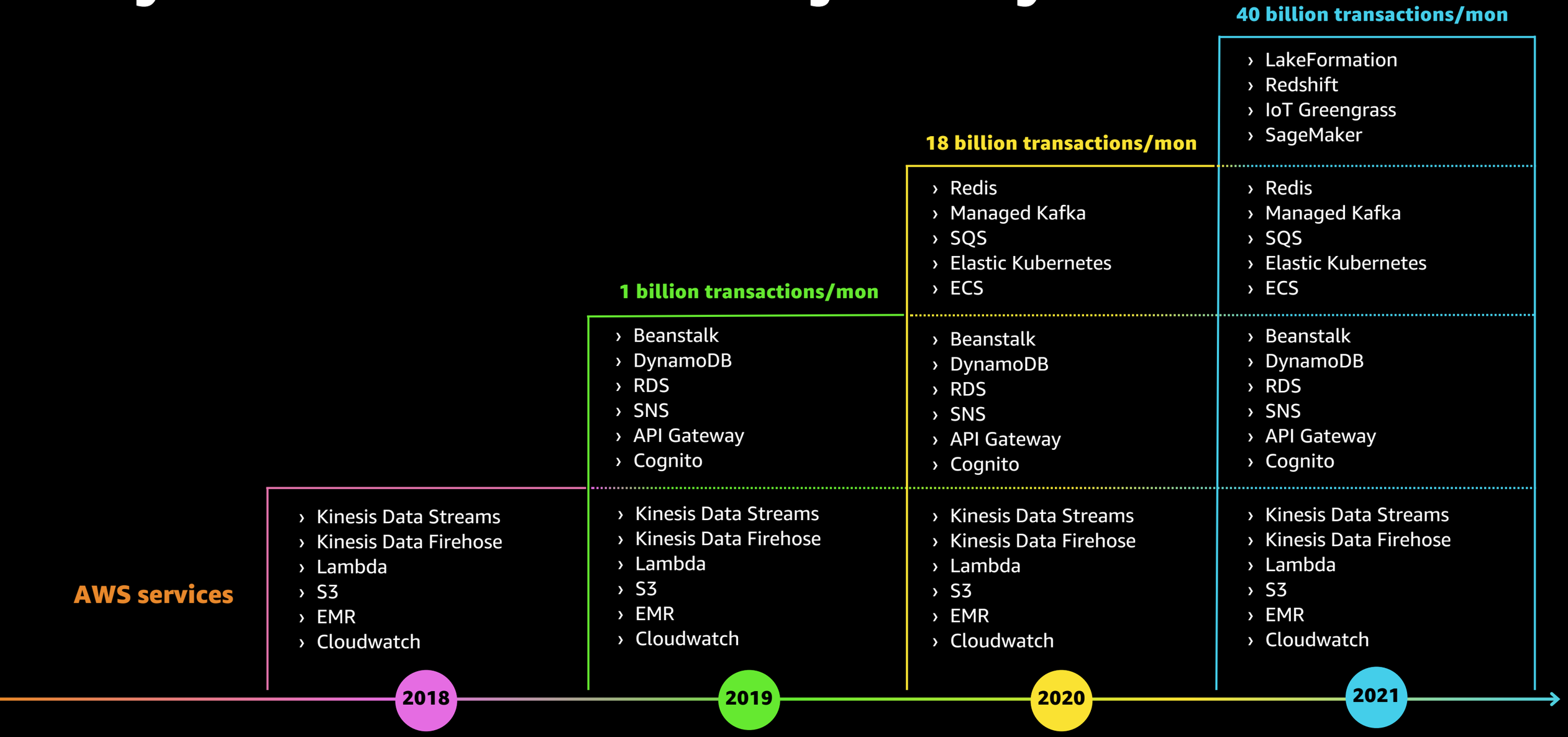
A peek into the future



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Toyota Connected cloud journey



Thank you!



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