AWS re:Invent

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AUT304

Developing a platform for software-defined vehicles

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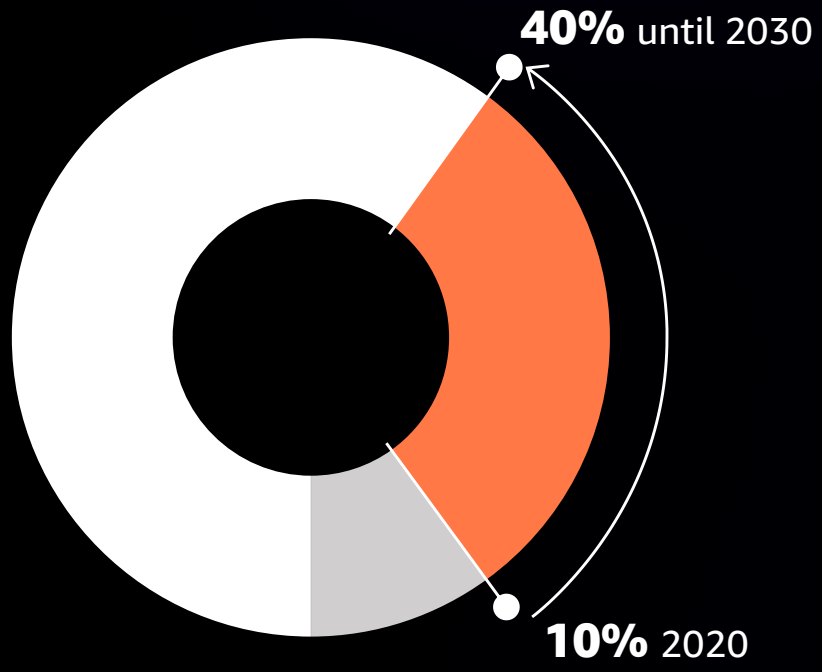
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Software is booming in the automotive market

THE RAPID DEVELOPMENT OFFERS THESE OPPORTUNITIES FOR CONTINENTAL

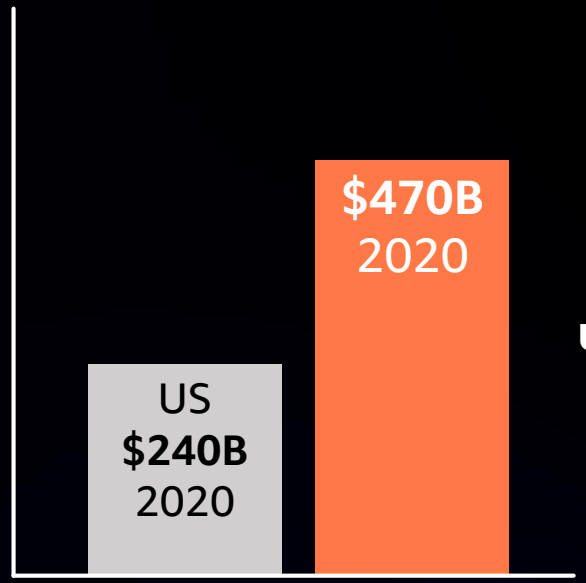
Increasingly intelligent

Functions controlled by software

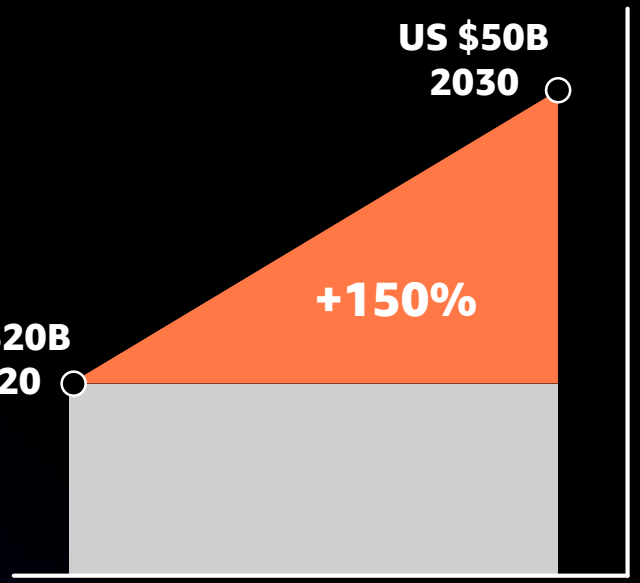


Strong growth

Overall market for software and electrical components



Sales in automotive software



Already today . . . → **90%** of all innovations already come from software and electronics

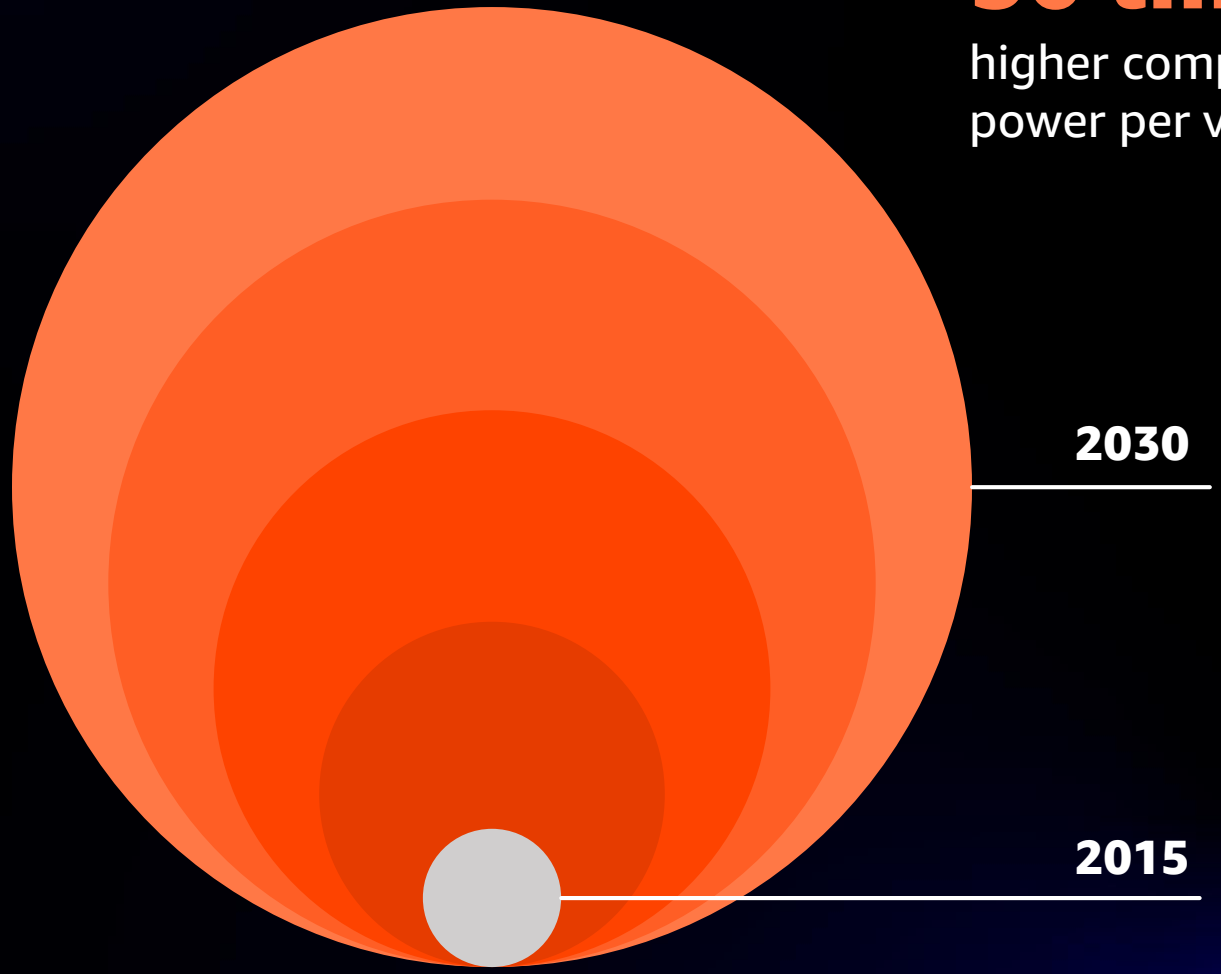
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More power

RAPID DEVELOPMENT OF SOFTWARE IN CARS

50 times
higher computing power per vehicle



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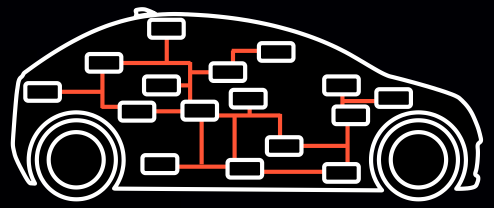
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IoT ecosystem architecture transformation

COMPLEXITY & FUNCTIONAL GROWTH WITH CURRENT APPROACH REACHING ITS LIMITS

Up2now





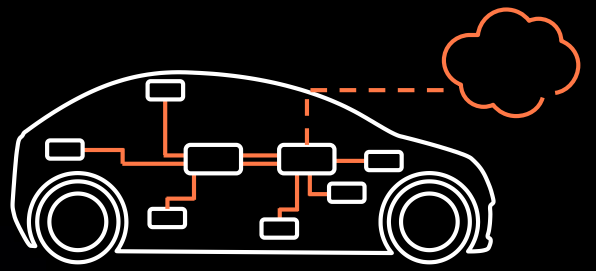
Patchwork architecture

- Up to ~100 ECUs, limited computing power
- Functionality isolated in ECUs
- Lots of wires
- Limited cloud-based functionality

User expectation: pleasure, safety, and convenience

Going forward





Function-defined architecture

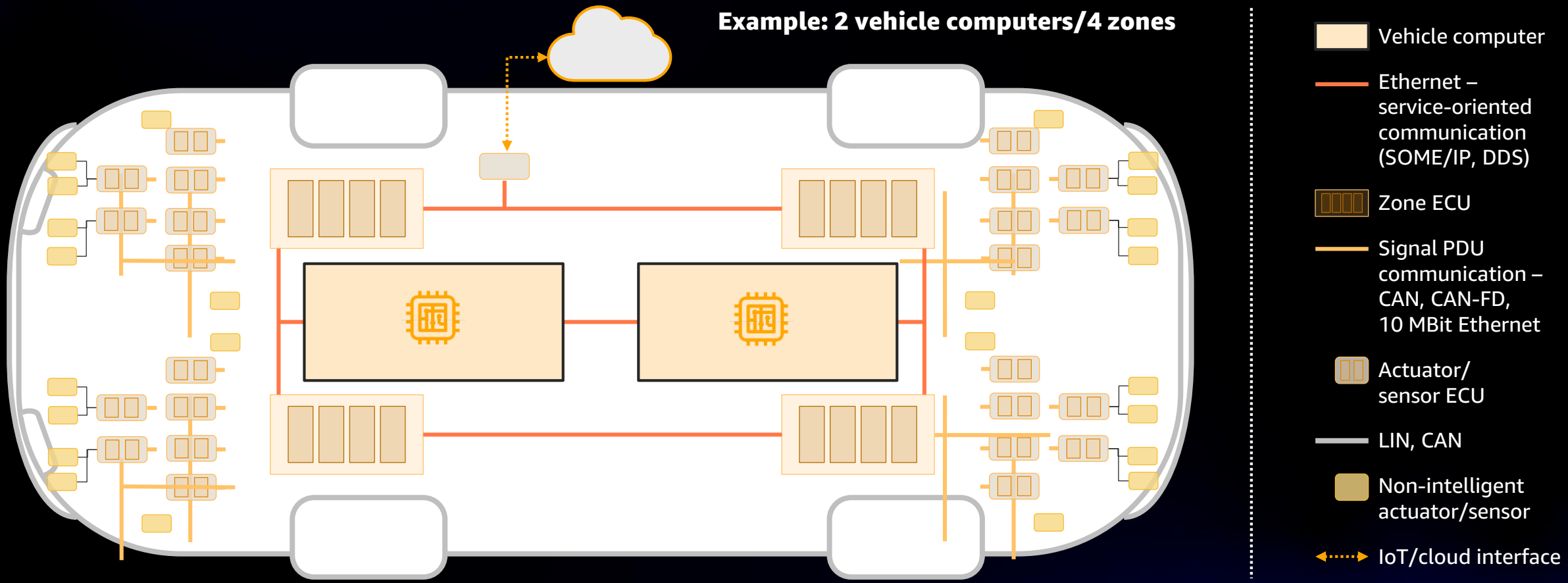
- Few high-performance computers and zone control, significant computing power
- Functions defined by software (hardware abstraction)
- ~50% reduction of wires
- Always connected

User expectation: smart IoT device

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IoT ecosystem architecture transformation

SERVER/ZONE – ARCHITECTURE, NETWORKING & CONNECTIVITY



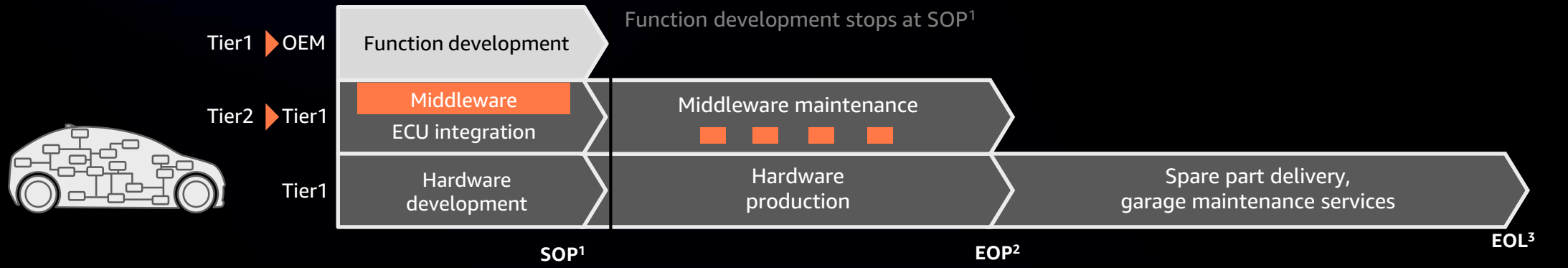
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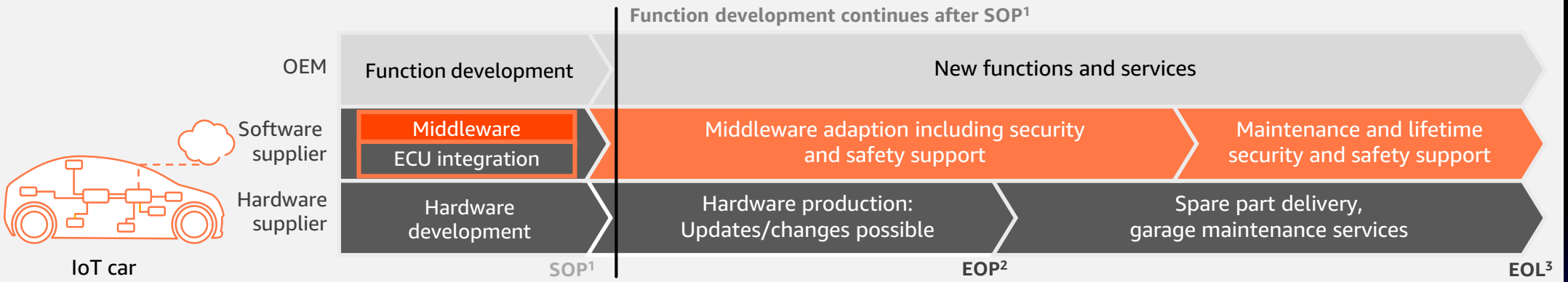
IoT ecosystem architecture transformation

TRUST-BASED COLLABORATION & PARTNERSHIP MODELS

Hardware and function coupling – software treated like hardware



Software-defined vehicle needs a software platform partner throughout vehicle lifecycle



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IoT ecosystem architecture transformation

SYSTEM INTEGRATION . . . FROM SUPPLIER TO PARTNERSHIP

Broad experience of Continental on several HPC projects with various OEMs

Management of very large number of 3rd-party function integration into a server

Management of multi-OS system validation & integration on server hardware

Experience of product/system integration into the vehicle (network management, dependencies, decomposition . . .)

Example of one of the latest high-performance computer projects

13
Development locations around Europe





18
Companies working on the SW for a single ECU



>800
Continental developers

101001
011101
110001

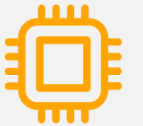
>70.000
Stakeholder requirements



>600
OEM and 3rd party developers



>1,8 million
Working hours at Continental to develop SW until now



68
Links to other Electronic Control Units (ECU)

OS

5 virtual ECU

5 different OS

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Continental group

LEADING THE WAY FOR YOUR MOBILITY



A leading player in **autonomous mobility**



First to market with **software-defined** vehicle architecture



Industry benchmark

operational efficiency in **tires**



~235,000

talented and dedicated employees

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IoT ecosystem architecture transformation

CHANGING STAKEHOLDER REQUIREMENTS



Addressing stakeholder requirements

- Continuous evolution (digital lifecycle)
- V2X & cloud integration
- Time2Market
- Integration of 3rd-party software
- Safety, security & privacy



Impact to architecture

- Decoupling hardware from software & services
- Compute centralization
- Separate I/O from compute
- Cloud/IoT integration
- Platform & interface standardization



Drivers, differentiators & portfolio

- Driven by customer experience
- Software as main differentiator, innovation driver & asset
- Ability to provide solutions and integrate across IoT stack
- Scalable platforms and reusable building blocks

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IoT ecosystem architecture transformation

FROM DOMAIN TO FUNCTION ORIENTATION

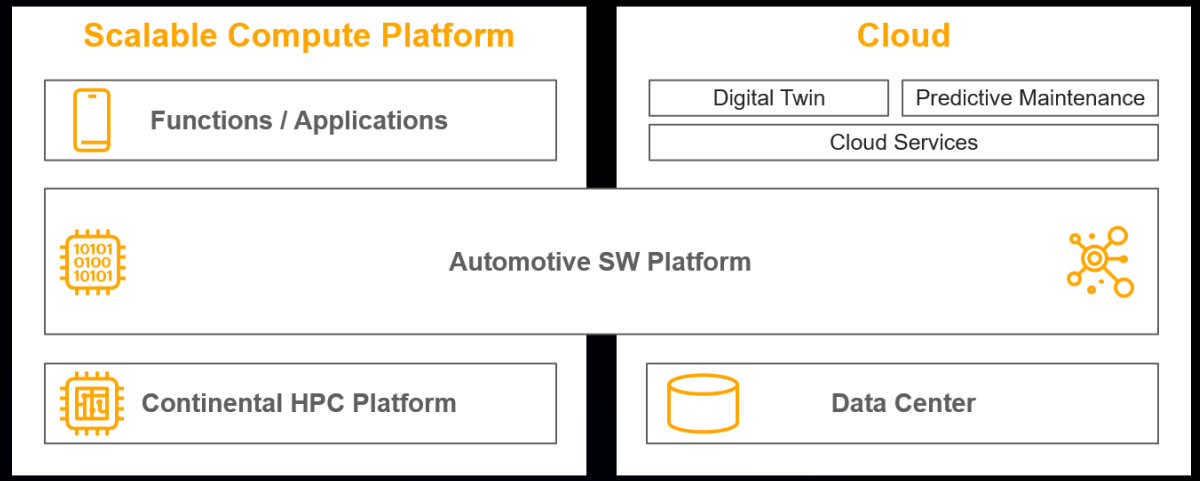
Up2now

Going forward

Domain-oriented

Interior cockpit/ HMI	Body & comfort	ADAS	Safety/ motion	...
Appl.	Appl.	Appl.	Appl.	Appl.
SW/ OS	SW/ OS	SW/ OS	SW/ OS	SW/ OS
HW	HW	HW	HW	HW
...	...	...	...	...

Function-defined & service-oriented



Vertical integration
full solution/ stack that OEM can leverage

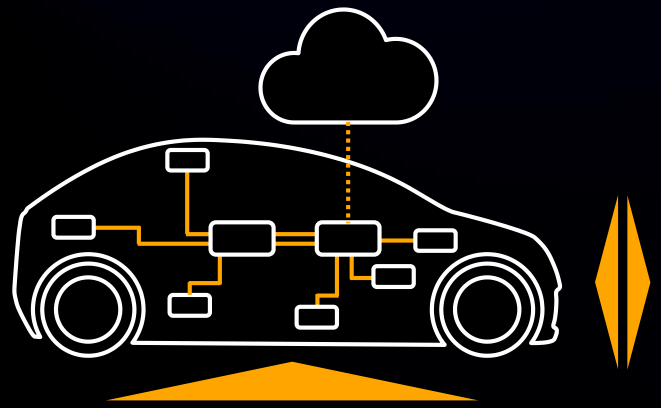
Horizontal integration
synergies, reuse, and maturity/quality

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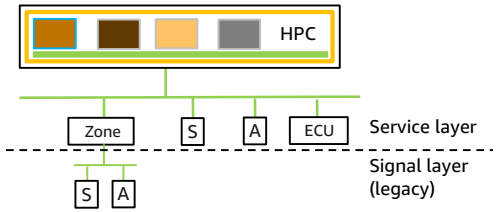
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IoT ecosystem architecture transformation

OUR FULL-STACK IOT PLATFORM ARCHITECTURE SOLUTION



Scalable compute platform



Vehicle infrastructure

DevOps workbench

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Toolchain | CI/CD* | SW distribution | Collaboration | Monitoring | Analytics

Scalable compute platform

Functions/applications

Body | Cockpit | ADAS/ AD | Safety/ motion

Automotive software platform

Platform services

Middleware | Edge enabler | Core software/OS

Simulation & validation services

Continental HPC platform

SoC | SoM | HPC

Cloud

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Digital Twin | Predictive maintenance

Cloud services

Data center

Cloud/on premises

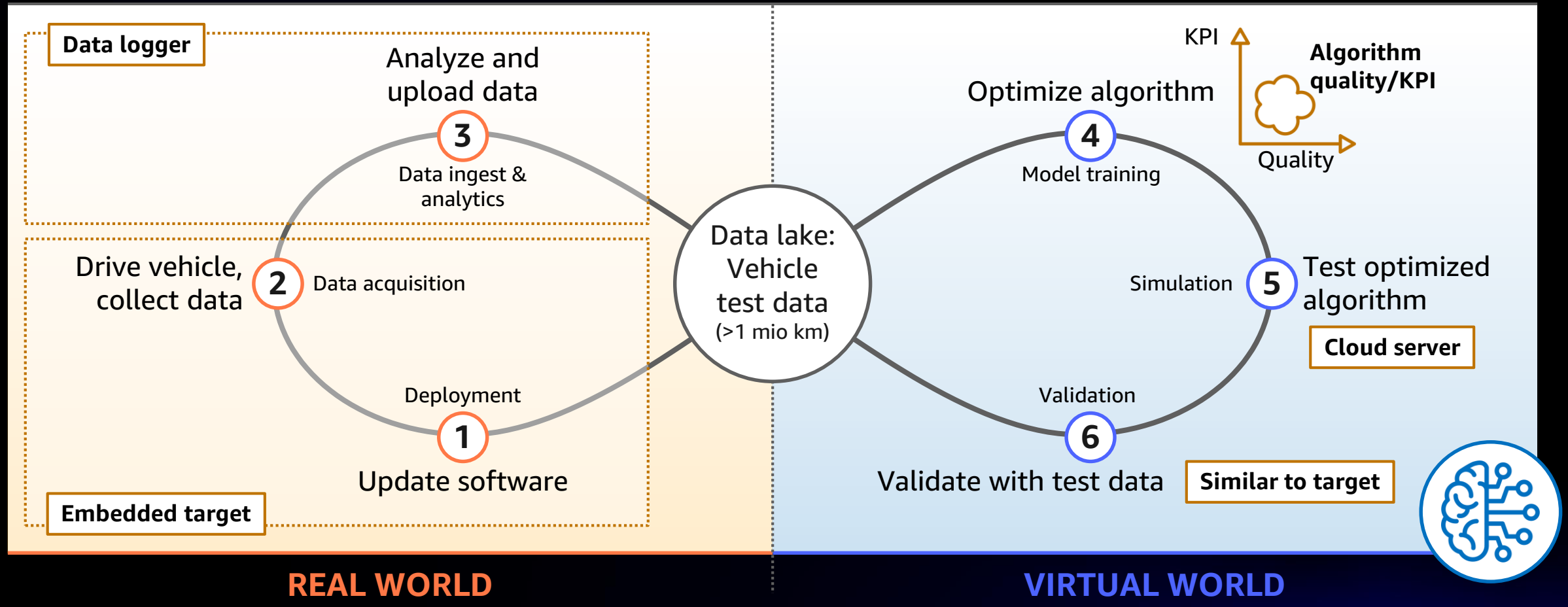
Vehicle infrastructure | Sensors | Zones/ECUs | Actuators

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IoT ecosystem architecture transformation

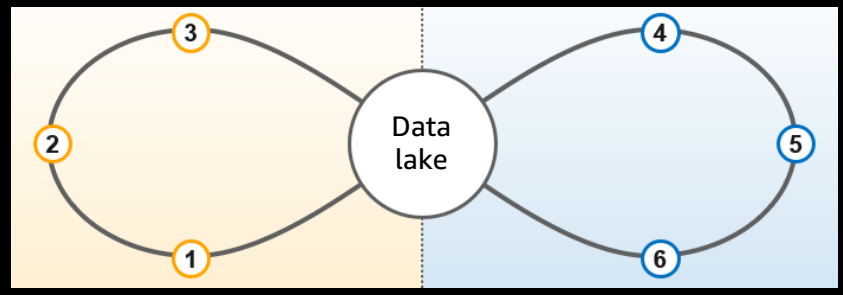
VALIDATION OF ADAS/AD FUNCTIONS (FIELD OPERATION TEST)

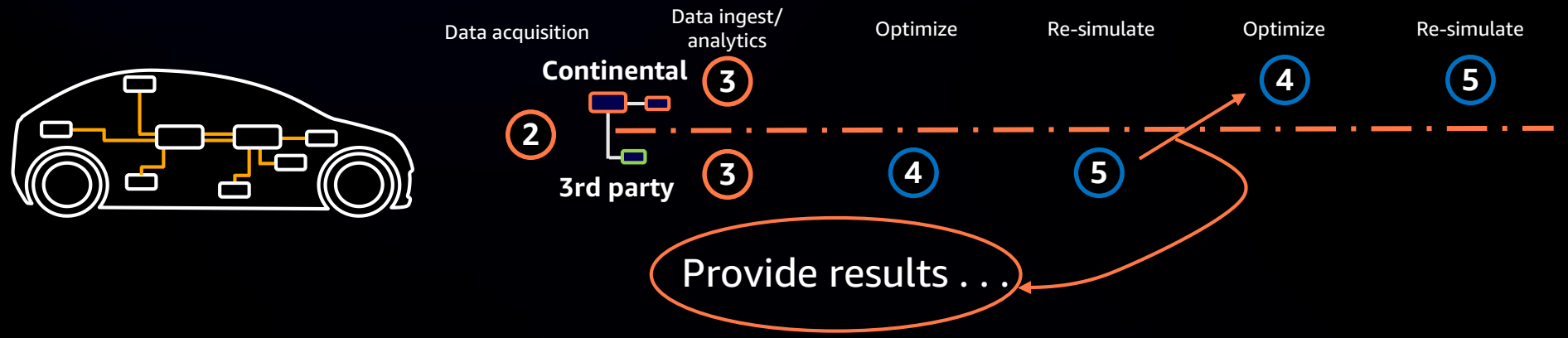


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Gain efficiency

ENABLE DIRECT COMMUNICATION





- 3rd party uploads data to exchange portal
- Continental engineer downloads data
- Continental engineer copies data to sim input

Processing time (including interaction) 4 . . . 10 days

without CAEdge

- 3rd party grants access to Amazon S3 bucket
- DevOps pipeline starts automatically as soon as new data is available

Processing time (including interaction) 15 minutes

with CAEdge

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Gain efficiency

ENABLE DIRECT COMMUNICATION

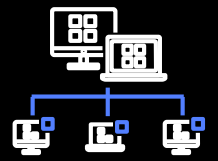
FOT 3rd-party data exchange



- 3rd party uploads data to exchange portal
- Continental engineer downloads data
- Continental engineer copies data to sim input

Processing time
(including interaction)
4 . . .10 days

without CAEdge



- 3rd party grants access to Amazon S3 bucket
- DevOps pipeline starts automatically as soon as new data are available

Processing time
(including interaction)
15 minutes

with CAEdge

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IoT ecosystem architecture transformation

DEVELOPMENT KITS TO ENABLE EFFICIENT PRODUCT DEVELOPMENT



- **Harmonize** development and integration of distributed services and applications
- **Provide** a platform solution, clear interfaces, and development environment
- **Enable** seamless development of service-oriented IoT ecosystem architectures

SCP = Scalable Compute Platform; ZCU = Zone Control Unit

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Continental Automotive Edge Framework (CAEdge)

AUTOMOTIVE SYSTEM DEVELOPMENT FROM IDEA TO ROLLOUT IN JUST A GLIMPSE

CAEdge enables faster development and deployment of distributed functions for scalable vehicle computing platforms across the IoT mobility ecosystem (vehicle/HPC, cloud, mobile . . .)

CAEdge provides interchangeable building blocks with predefined, easy-to-adapt interfaces across the stack covering hardware, software, tooling, and the cloud

Customers can start immediately using the cloud, HPC Development Kit, and SEK (E2E System Exploration Kit) without production hardware – all you need is an account



Modular and scalable compute platform providing a stable environment for all domain HPC software development

Automotive-grade designed building blocks and system capabilities providing a clear path to production

Cohesive, integrated tool framework with user-friendly and fast software development and operations

Non-differentiating automotive-grade OS and middleware enabling easy function development (from EB)

Cloud as scalable extension With on-premises resources providing unlimited potentials for services and functions

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Project approach: Delivering an agile platform in an agile way

Key project areas

Skills and ownership

- Run trainings and hackathons
- Implement agile methodology and run joined PI planning
- Builder responsibility
- Security lead

Expert integration

- Integrate experts from all fileds
- Establish know-how exchange
- Direct access to ISV/tool provider

Pilot project

- Pilot project to set priorities
- Provide test cycles
- Blueprint project and platform
- Pilot and platform in 6 months

Enabling capabilities



AWS Identity and Access Management (IAM)



Amazon Managed Workflows for Apache Airflow



Amazon Elastic Container Service (Amazon ECS)

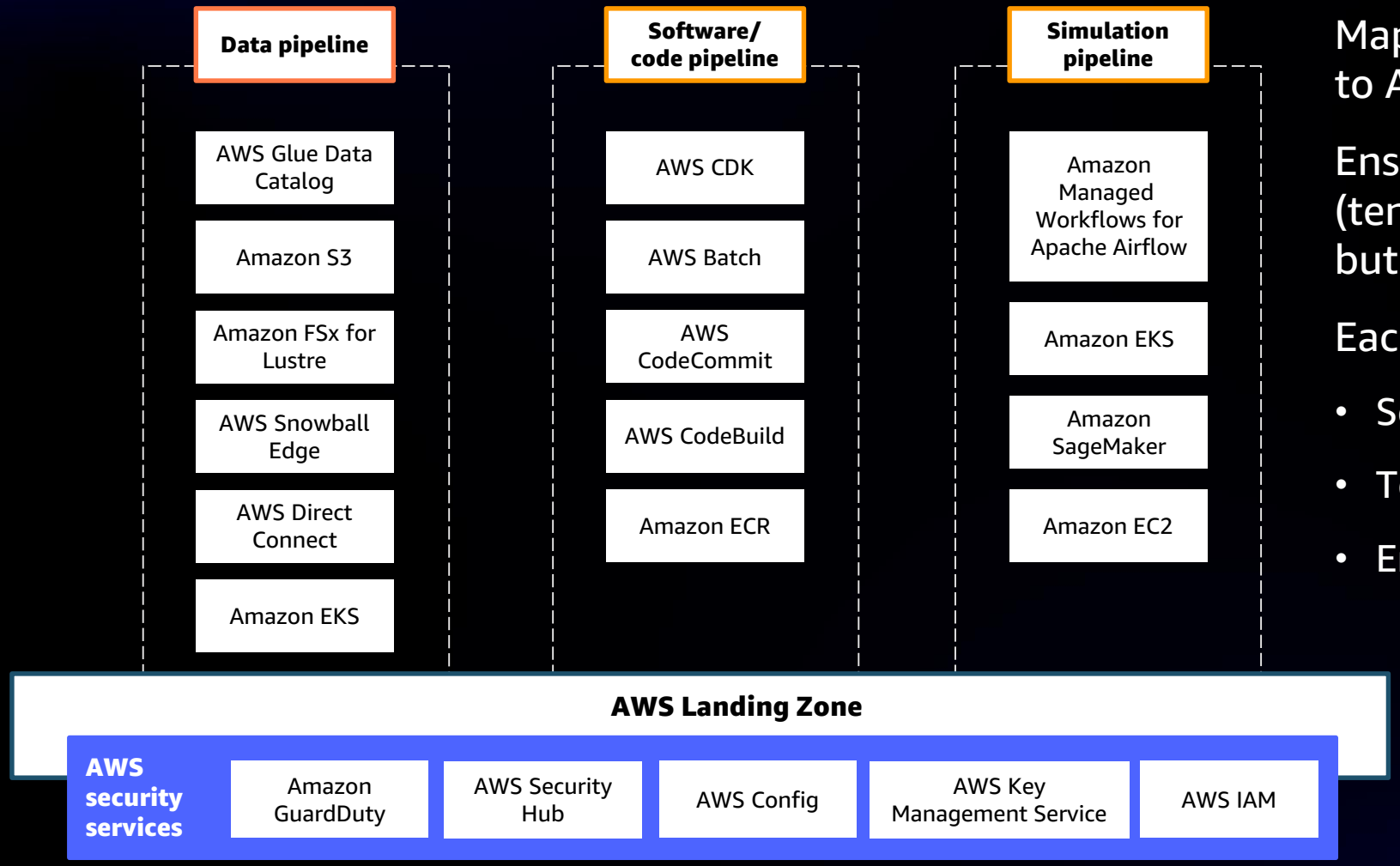


Amazon Elastic File System (Amazon EFS)

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Project approach: High-level team



Mapped initial solution stacks to AWS services

Ensured service know-how for security (tenancy), scale (compute, storage), but also regional extension

Each team

- Scrum manager
- Tech lead
- Engineers and tester

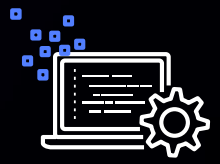
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Project approach: Hackathon



Objective

1. De-risk build of critical components and integrations
2. Establish team and agile ceremonies – collect initial velocity data
3. Early outcomes (MVP, POC) to allow early tests



Approach

1. Preparation (2 weeks) to identifiy key functions and critical tests to execute (tech spike)
2. Organize training, kickoff, and closing, including key stakeholder
3. Invite specialist that will later be required in the project to support
4. Run full 5-day hackathon

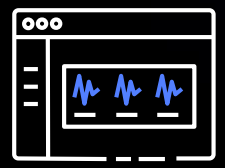


Outcome

1. 5 days, 50+ participants working on 4 workstreams
2. De-risk key components – onboarding simulation tooling and gathered initial performance data
3. Ingestion test for data (test) successfully completed to allow other components use to test data
4. Team established CSAT 4.5/5

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Lessons learned: Operations and maintenance



Operations Game Day and optimizations

- Execute Game Days for operations and security incidents – train for the unexpected
- Establish continous operations optimizations using AWS Trusted Advisor, AWS Cost Explorer, and user feedback
- Build dashboard to optimize insights and provide actionable alarms



Blueprint for projects

- Establish developer documentation to allow custom blueprints for engineering projects
- Extend integration of ISV products and productivity tooling (DevOps)
- Rapid onboarding guides and Quick Starts to support even more process automation

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