AWS re:Invent

NOV. 29 – DEC. 3, 2021 | LAS VEGAS, NV

MFG204

Transforming engineering and design

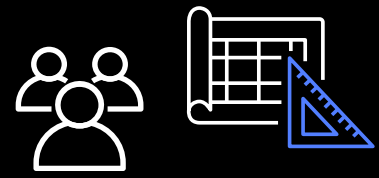
Mark Galbraith (he/him)
VP Productivity Engineering
Arm

David Pellerin (he/him)
Head of Business Development, Semiconductors
AWS

Walker Stemple (he/him)
R&D Solutions Lead, Enterprise and Industry
AWS

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AWS introduction



"How do we delight the customer?"

Priorities for product development teams

- Happy customers driving business growth
- Higher velocity, quality, and manufacturability
- Differentiation through value-adding services
- Sustainability – for full product lifecycles
- Talent hiring and retention – happy engineers!

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The new normal: Global companies and digital products

69%

of boards of directors have accelerated their digital initiatives in the wake of COVID-19 disruption

66%

of boards of directors list digital technology initiatives as the top strategic business priority for the next two years

65%

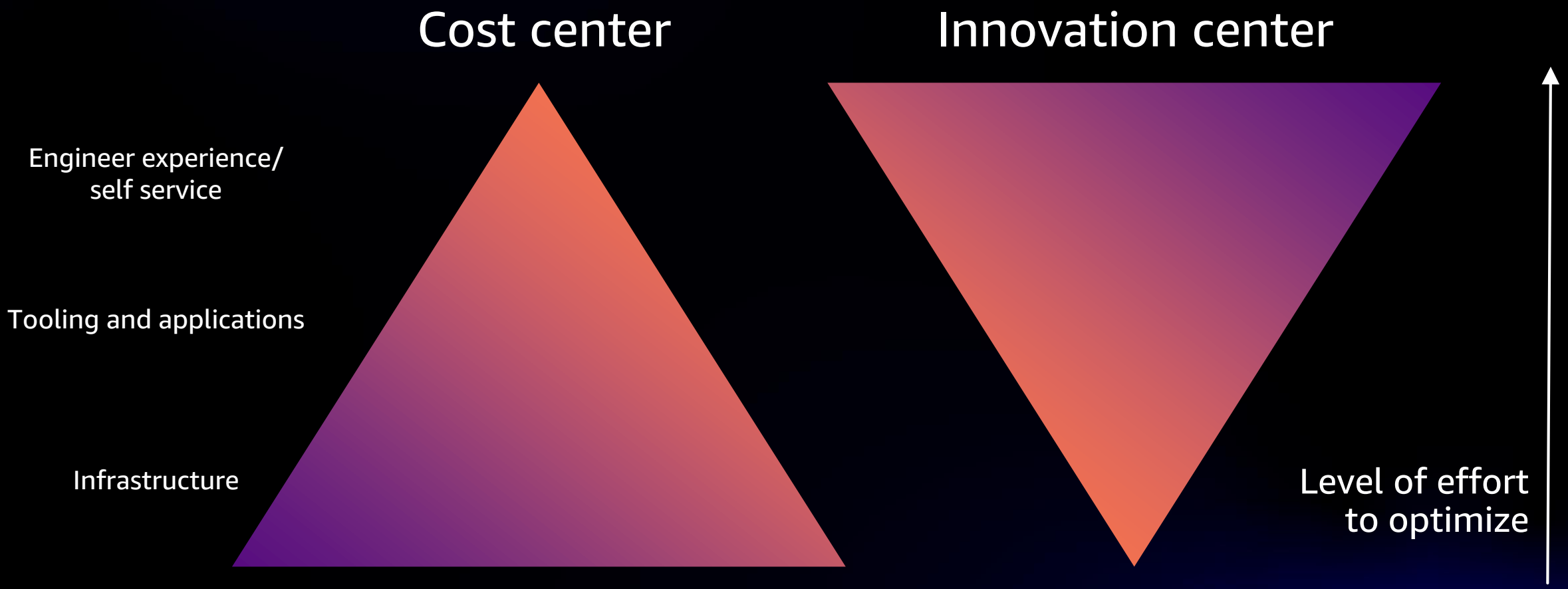
of boards of directors believe digital technology will lead to substantial or complete industry transformation by 2026

Source: Gartner, “Survey Analysis: Board Directors Say Pandemic Drives Increased Investments in IT,” Partha Iyengar, Apoorva Chhabra, Irving Tyler, Jorge Lopez, September 11, 2020.

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Digital engineering

Engineering as a:



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"Invention requires two things: the ability to try a lot of experiments, and not having to live with the collateral damage of failed experiments."



Andy Jassy
CEO, Amazon

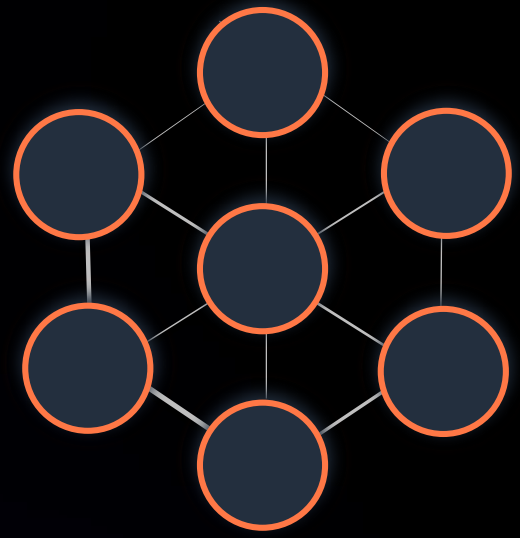
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When the impact of change is small, release velocity can increase



Monolithic application

Does everything
Shared release pipeline
Rigid scaling
High impact of change
Hard to adopt new technologies

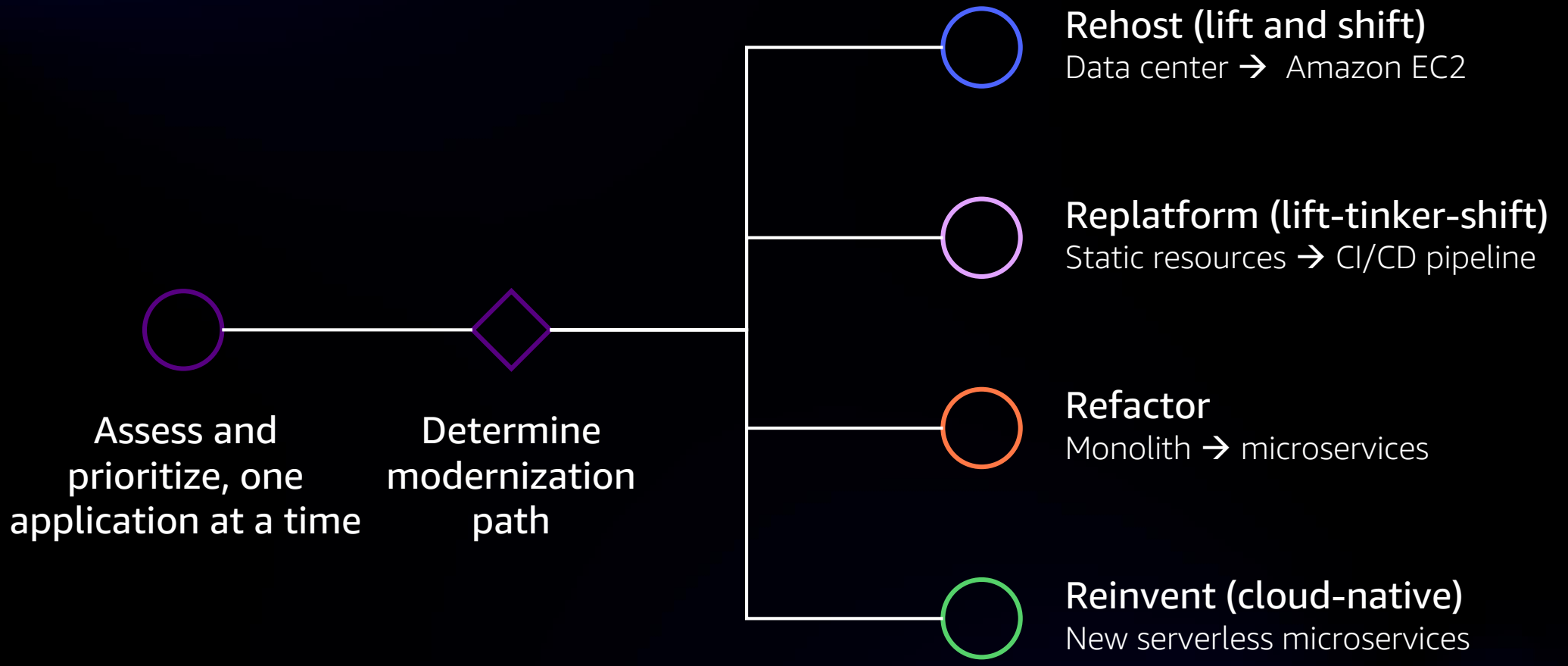


Microservices

Does one thing
Independent deployments
Independent scaling
Small impact of change
Choice of technology

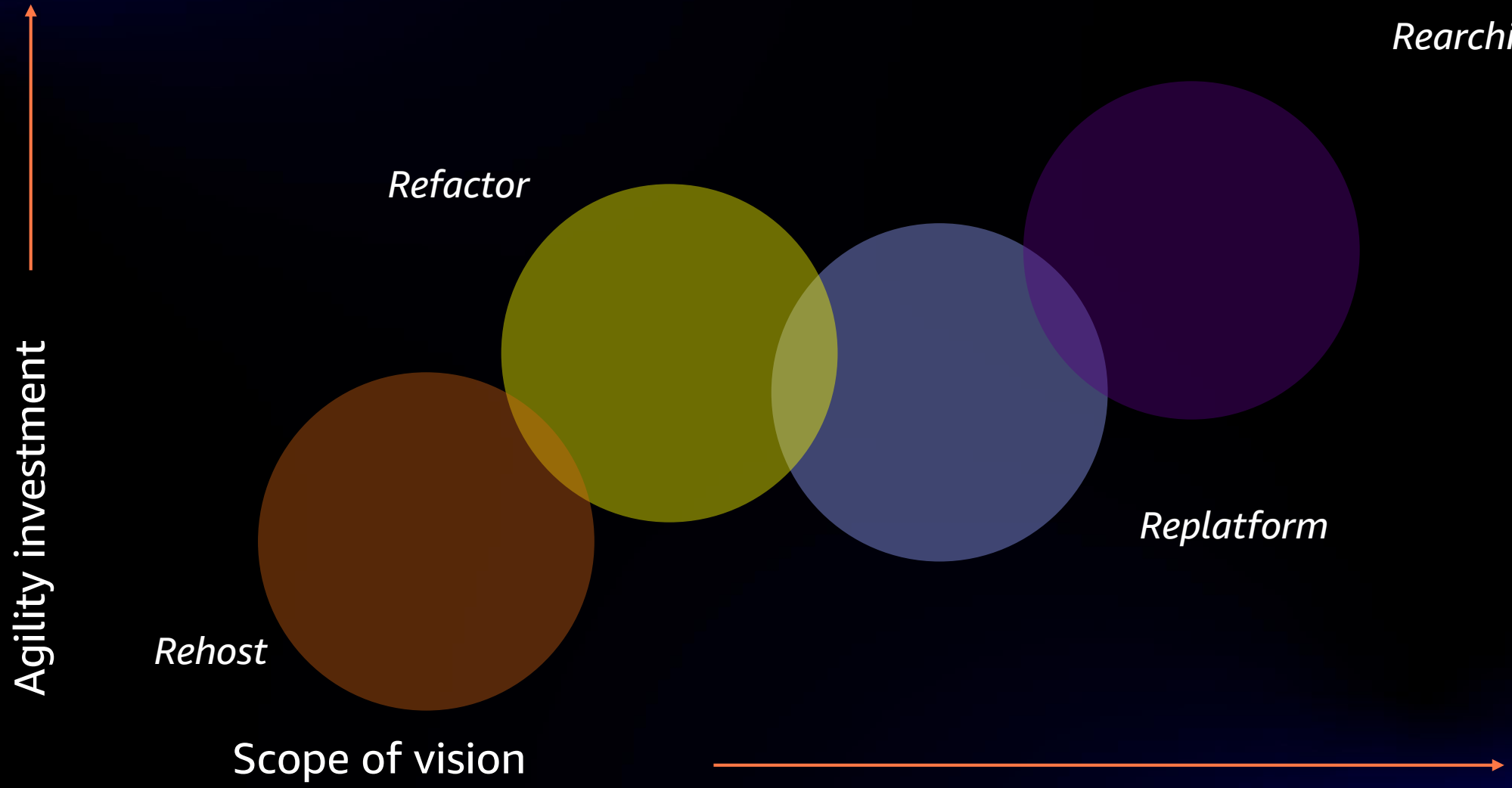
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Modernize applications one at a time



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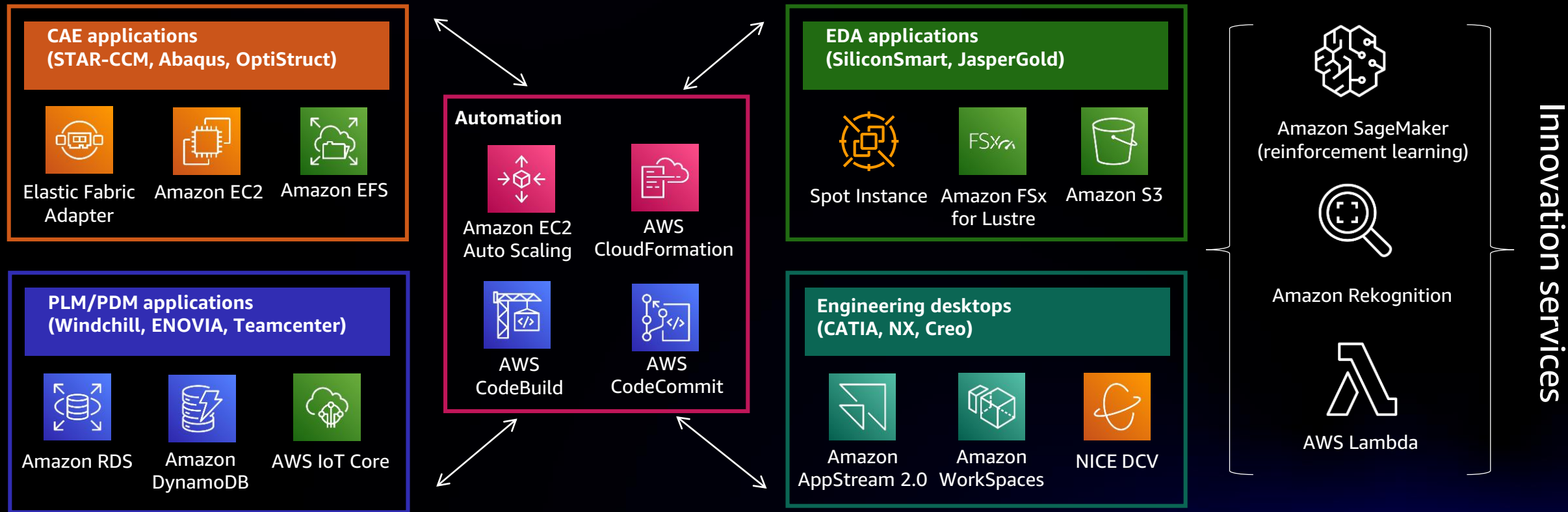
Engineering and design cloud journey success



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Simplify engineering modernization

- AWS offers **200+ services**
- Several services support modernization of E&D workloads **(EDA, CAD, CAE, PLM/cPDM)**
- Modernized workloads **reduce complexity** through **integration automation** and **managed services**

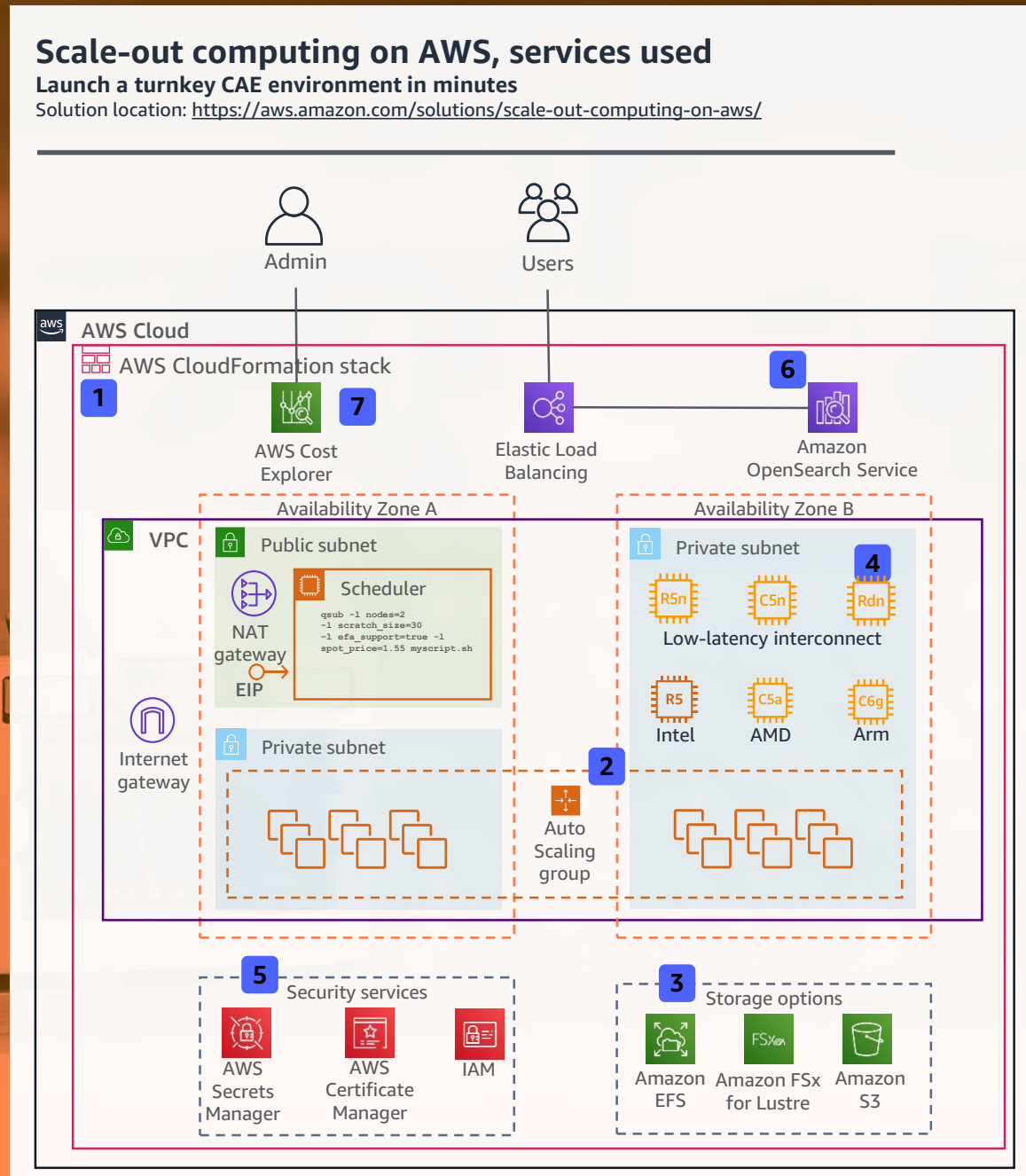


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Computer-aided engineering

1. Automated deployment of a production-ready CAE environment
2. Multiple Availability Zones **move the job** to the resources
3. Match workload I/O needs with object, file, block, and even parallel file system storage
4. Unlimited compute options – Arm, AMD, Intel, NVIDIA, FPGA, custom silicon – in any combination
5. Security services help ensure best practices for sensitive IP
6. Operational analytics dashboard for engineering and administration
7. Integrated cost allocation tracking notifications and dashboards

"AWS enables multidisciplinary optimization in every practical domain (wireless, structural, thermal, mechanical, etc.)." Jake Boswell, Amazon Lab126



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Multi-physics simulations for biopharma process development

Challenge

- Non-intuitive tools slow down science
- Lacking the ability for scientists to self-service flexible compute options
- Adapt workloads to the cloud while maintaining enterprise security and infrastructure guardrails

Solution

- CAE Scale-Out Computing on AWS open-source solution
- AWS customized platform with best practices, for security and user authentication
- 3D modeling and visualization as well as debugging of design applications

Benefits

- Improved end user experience for scientists and engineers to run simulations with a simple interface
- Amgen team to seamlessly integrates with existing governance practices
- Simulation jobs in AWS Solution uses pay-as-you-go pricing models so processing tasks are more cost effective than on premises solutions and other cloud HPC providers

"The advances made for Amgen's HPC capabilities as a part of this partnership are fully aligned with our broader in silico modeling platform. They not only benefit design and development of novel products and processes, but the technology is essential to accelerate our digital twin roadmap."

Pablo Rolandi, Director, Process Development, Amgen

AMGEN



Company: Amgen
Industry: Life sciences
Country: United States
Website: www.amgen.com

Amgen is committed to unlocking the potential of biology for patients suffering from serious illnesses by discovering, developing, manufacturing, and delivering innovative human therapeutics.

Why develop products using AWS?

Virtually unlimited infrastructure enabling scaling and agility not attainable on premises



Better ROI

Instant **access to latest technologies, including HPC and AI/ML,** with no lengthy procurement cycles or big capital investments



Faster time to results

Flexible configuration options quickly iterate **resource selection** and ensure **cost optimization**

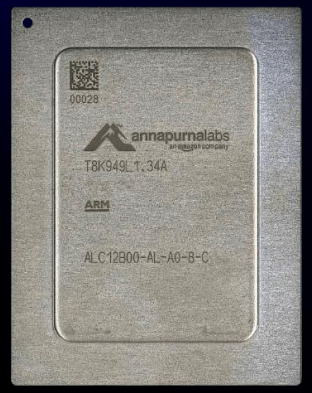


Enable **rapid, data-driven innovation**

Happier customers, happier engineers

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At Amazon, working backwards from customers leads to rapid product innovation

We design much of our own hardware, and we source from a global supply chain

Amazon has multiple globally distributed teams for:

- Data center infrastructure
- Consumer devices
- Robotics and AI
- And more

We benefit from secure, cloud-based design and collaboration for IC, system-on-chip, and full product development





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A data-driven approach to product R&D

System-level design

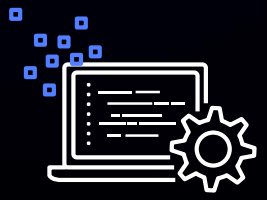
Implementation and verification

Semiconductor fabrication

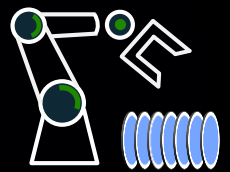
Packaging, assembly, and test

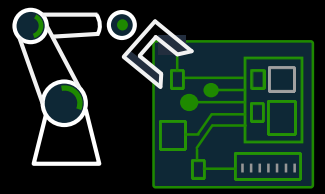














"How do we delight the customer?"

Supply chain collaboration, security, and intelligence

Next-gen connected devices



Project data (PLM)



CAE/EDA tools



Intellectual property (IP)



Software and firmware



Mechanical design (CAD)

Smart design | Smart verification | Smart fab | Smart products

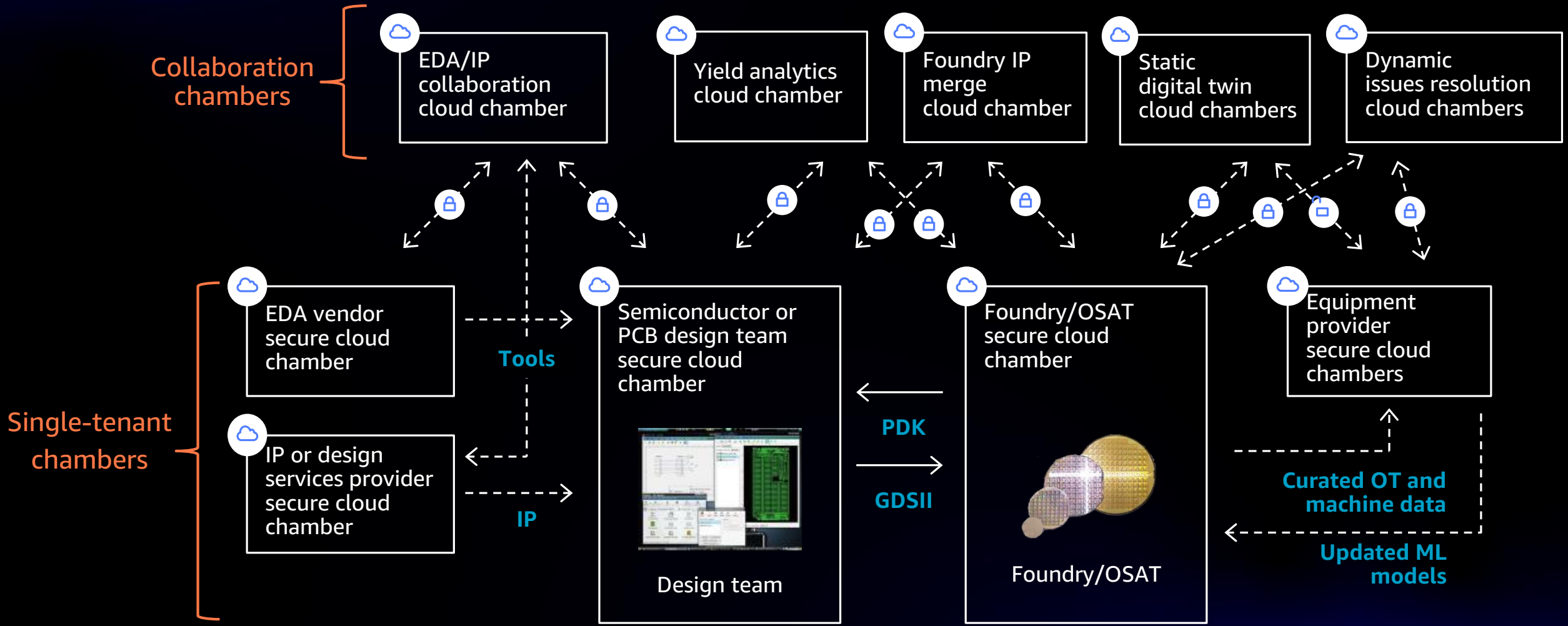
Rapid, data-driven innovation – without IT constraints

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Cloud enables trusted collaboration

USE CASES THROUGHOUT THE SUPPLY CHAIN

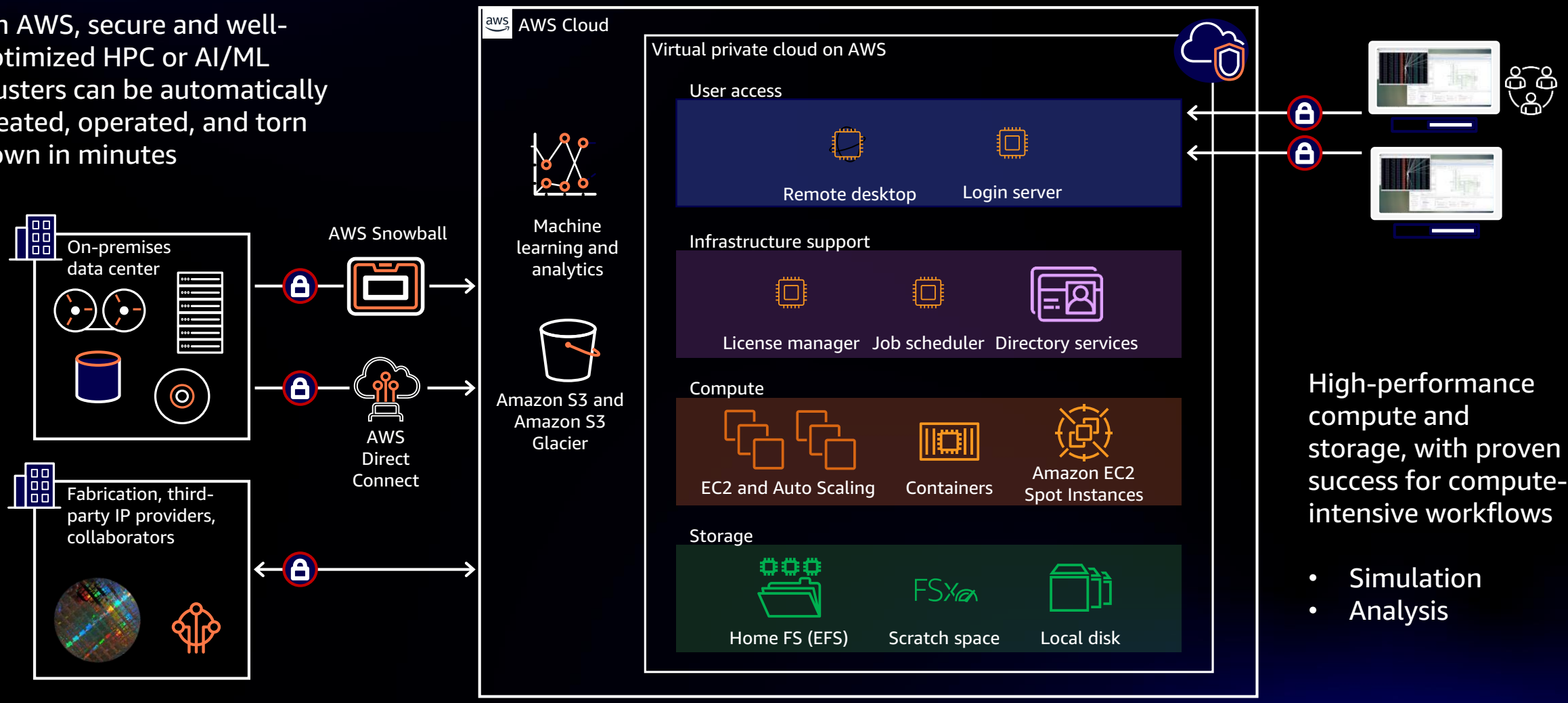


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Secure collaboration deployed on AWS

INTELLIGENT, SECURE, AND SCALABLE

On AWS, secure and well-optimized HPC or AI/ML clusters can be automatically created, operated, and torn down in minutes



High-performance compute and storage, with proven success for compute-intensive workflows

- Simulation
- Analysis

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Our speaker today



Mark Galbraith (he/him)

VP Productivity Engineering

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The journey to the Arm Cloud

Mark Galbraith (he/him)
VP Productivity Engineering
Arm

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Agenda

Who is Arm?

IP and SoC design process

Why Arm in the cloud?

Electronic Design Automation (EDA) tools and performance

Case study – physical IP design

Case study – hardware IP verification

Case study – software development

Journey to the Arm Cloud summary

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70%

of the world's population use Arm processor technology

From inception to now

1990

Joint venture between Acorn Computers, Apple, and VLSI Technology





Designed into first mobile phones and then smartphones

1993 onward

Today

Now all electronic devices can use intelligent Arm



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Sparking the world's potential



Semiconductor IP business

The global leader in the development of licensable compute technology

R&D outsourcing for semiconductor companies

Focused on freedom and flexibility to innovate

Technology reused across multiple applications

With a partnership-based culture & business model

Licensees take advantage of learnings from a uniquely collaborative ecosystem

2,000 licenses
Growing by 100+ every year

530 licensees
Industry leaders and high-growth startups; chip companies and OEMs

200 billion
Arm-based chips shipped to date

25 billion
Arm-based chips shipped in 2020

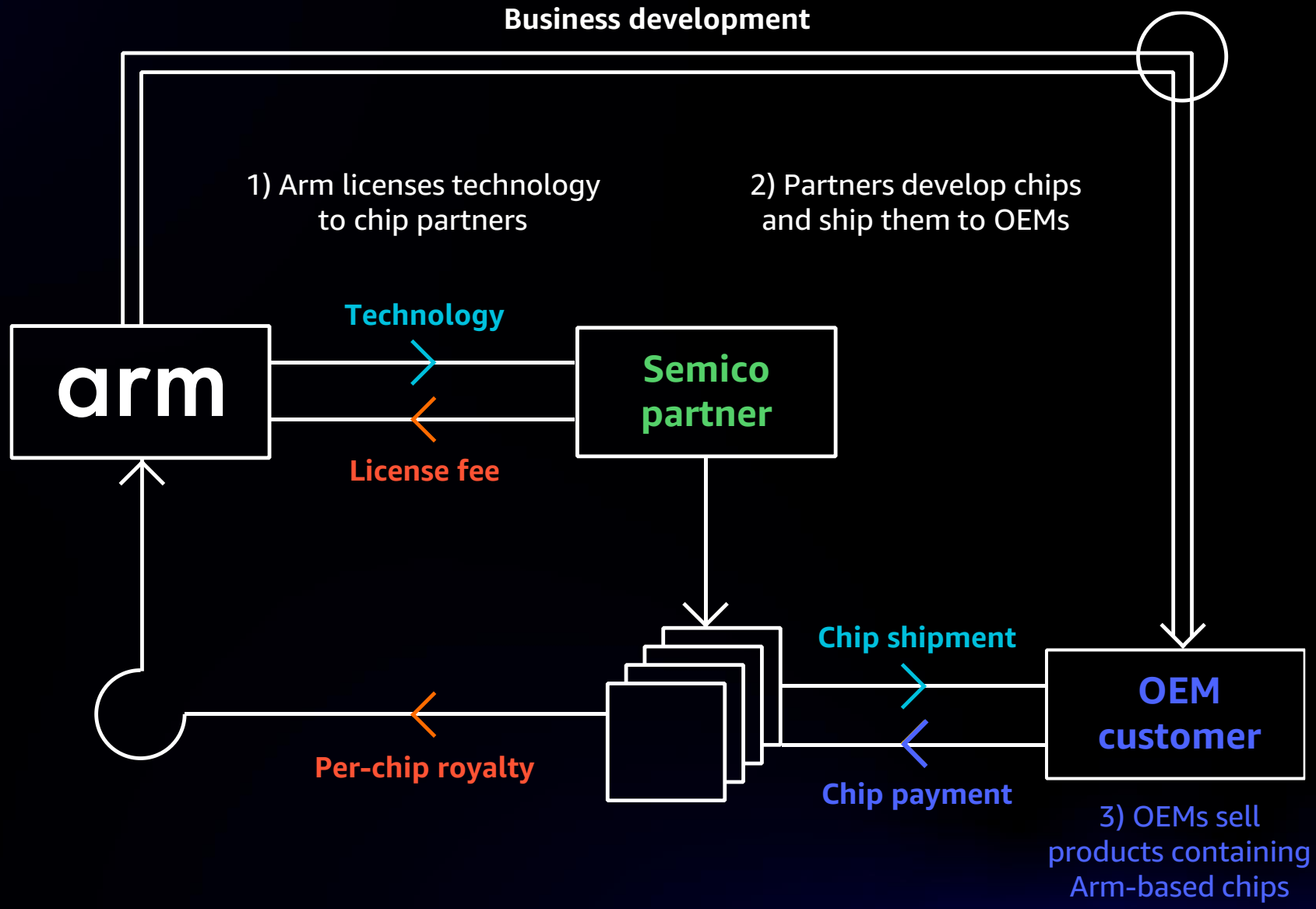
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A continuous partnership model

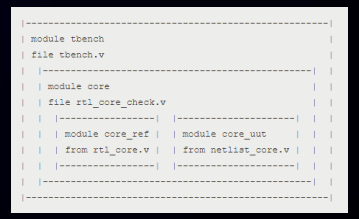
Arm develops technology that is licensed to semiconductor companies

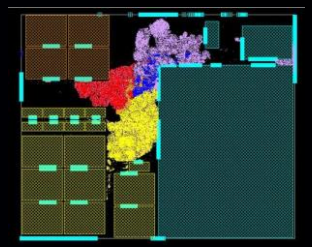
Arm receives an upfront license fee and a royalty on every chip that contains its technology



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Chip creation





Making a chip can cost $MM – design has to be right the first time



IC design house

Requirements → Design → Validation → Implementation → Validation → Tapeout → Fabrication

Arm CPU/GPU etc.

Design → Validation

Pre-validated CPU block

Simulation (front end)

Pre-validated cell library

Pre-validated cell library

Chip



Arm physical IP

Design → Validation

Simulation (backend)

10s–100s of millions of CPU hours spent in simulation to test designs

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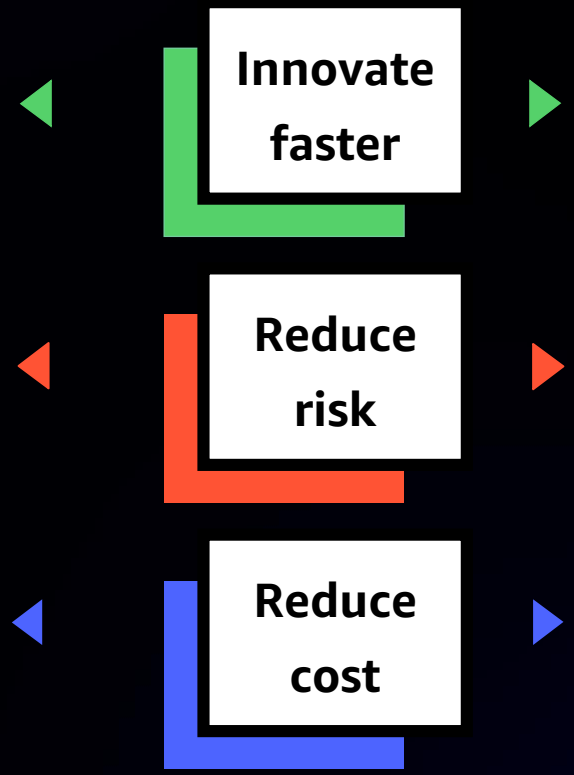
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Why cloud for silicon design and verification?

INCREASING DEMANDS ON RESOURCES TO MEET TOMORROW'S NEEDS

On-premises challenges ✖

- Limited capacity, cannot scale on an on-demand basis
- Overutilization of and rightsizing the hardware, lack of the right hardware for the right job at the right time
- Underutilization of hardware resources



✔ Benefits of cloud

- Design/verify complex SoCs faster, leading to faster time to revenue
- On-demand scaling of resources
- Work seamlessly and securely with third-party partners
- Meet tight project deadlines especially during tapeout
- Resolve bugs quickly by scaling up
- Save of millions of dollars
- Minimize IT capital expenditure
- Maximize valuable engineering time
- Overall TCO reduction

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AWS M6g, R6g, C6g, X2gd instances

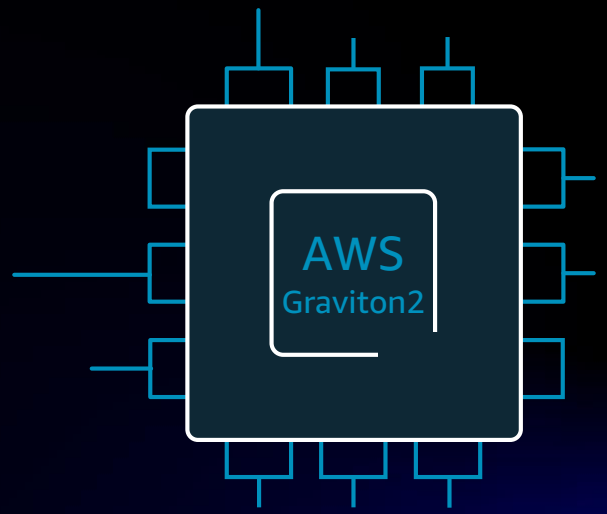
POWERED BY AWS GRAVITON2 PROCESSORS WITH ARM NEOVERSE N1 CORES

AWS Graviton2 processor

- 7x performance, 4x compute cores, and 5x faster memory (vs. Graviton)
- Built with 64-bit Arm Neoverse cores with AWS-designed silicon using 7 nm manufacturing technology
- Up to 64 vCPUs, 25 Gbps enhanced networking, 18 Gbps EBS bandwidth

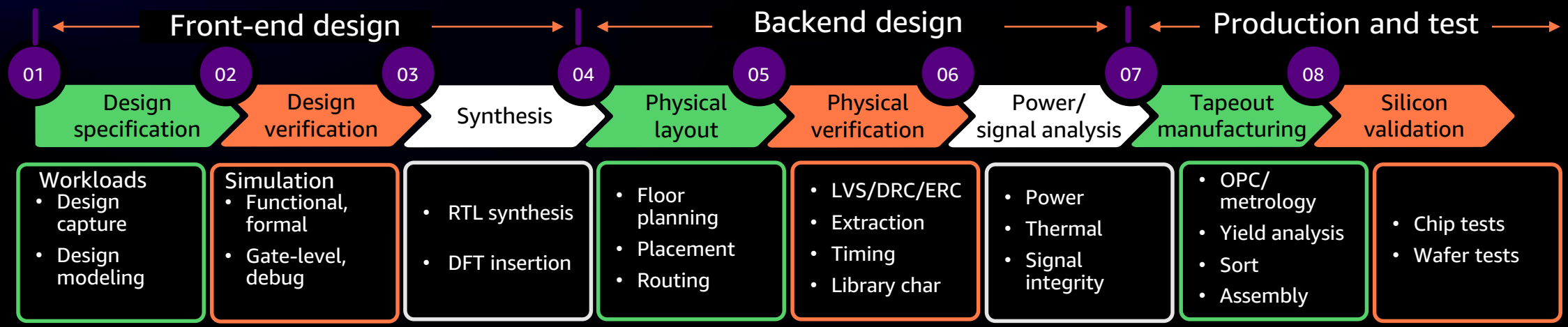
New generation of Arm Neoverse-based instances powered by AWS Graviton2 processors offers **40% better price-performance** than 5th-gen x86-based instances and are better suited for EDA use cases

C6g	M6g	R6g	X2gd
2 GB per CPU	4 GB per CPU	8 GB per CPU	16 GB per CPU



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EDA tools availability for Arm



	Functional simulation	Formal	Debug	Characterization/ simulation
SYNOPSYS®	VCS	VC Formal	Verdi	SiliconSmart → PrimeLib, CustomSim
cadence®	Xcelium	JasperGold	Indago	Liberate Trio, Spectre Simulation Platform, Spectre XPS
SIEMENS	Questa Prime	Questa PropCheck		Solido
Ansys				APL → RedHawk-SC

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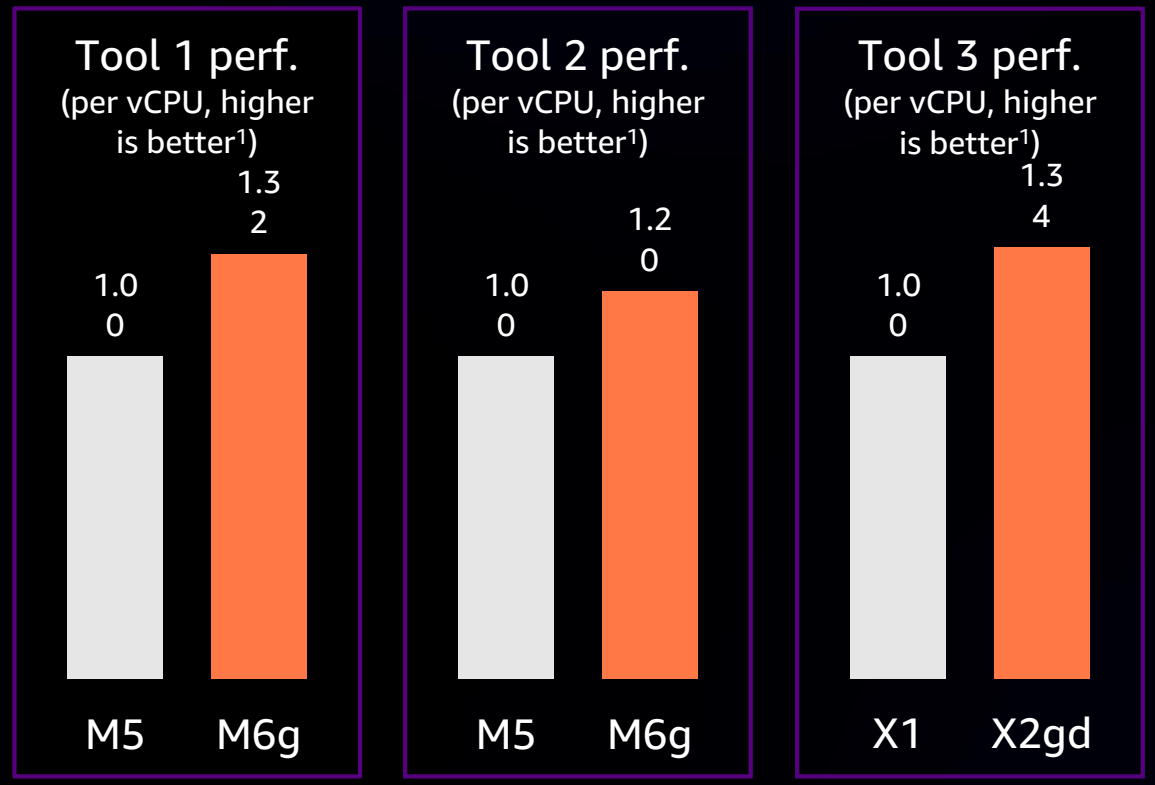
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EDA ecosystem landscape on Arm

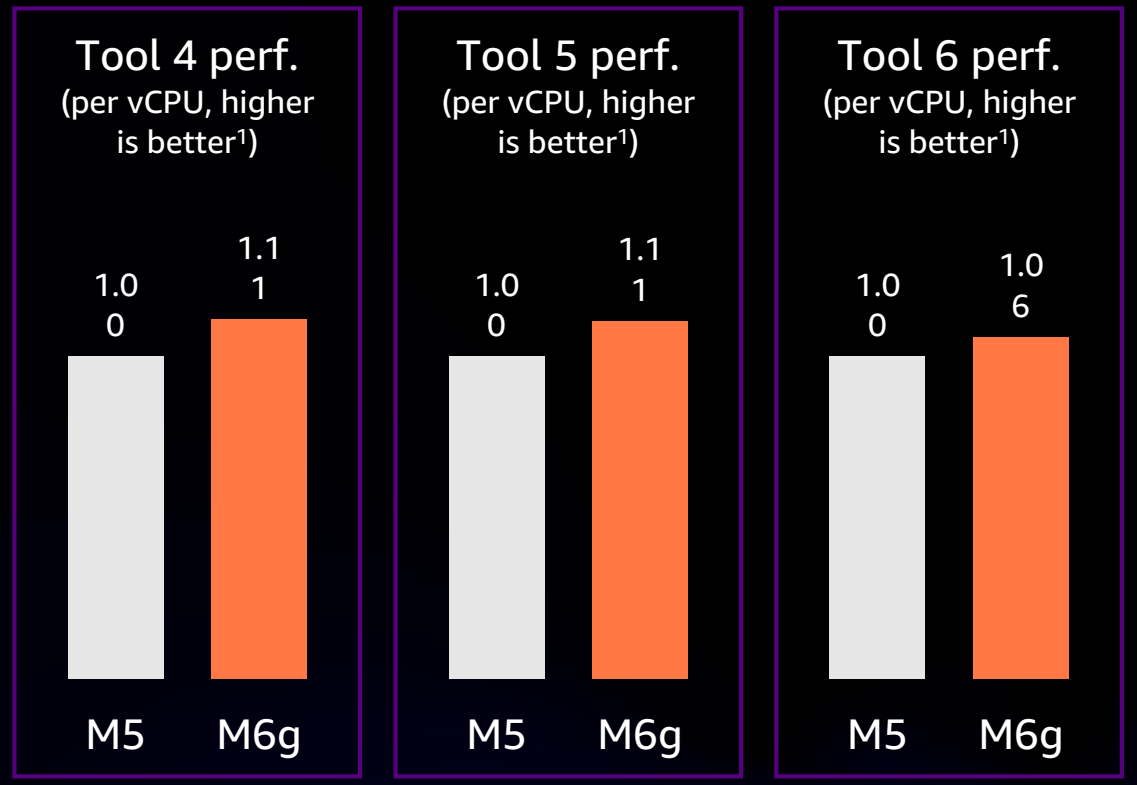
AWS GRAVITON2 FAMILY VS. X86

Ansys
cadence
SIEMENS
SYNOPSYS

Front-end EDA tool performance



Backend EDA tool performance



1. Performance is measured as simulation jobs per unit time
2. Percentage is based on price per simulation job, using on-demand list price

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Physical IP design in the Arm Cloud

The need

Compute-intensive workloads along with dynamic business environment made scalability and elasticity of the cloud the best fit for the needs of physical IP design

Arm's Physical Design Group (PDG) today

- Running production workloads on AWS since 2019
- 80% of PDG's usage on AWS is Graviton2 today
- Taking advantage of the performance and cost using Arm-based Graviton2 family

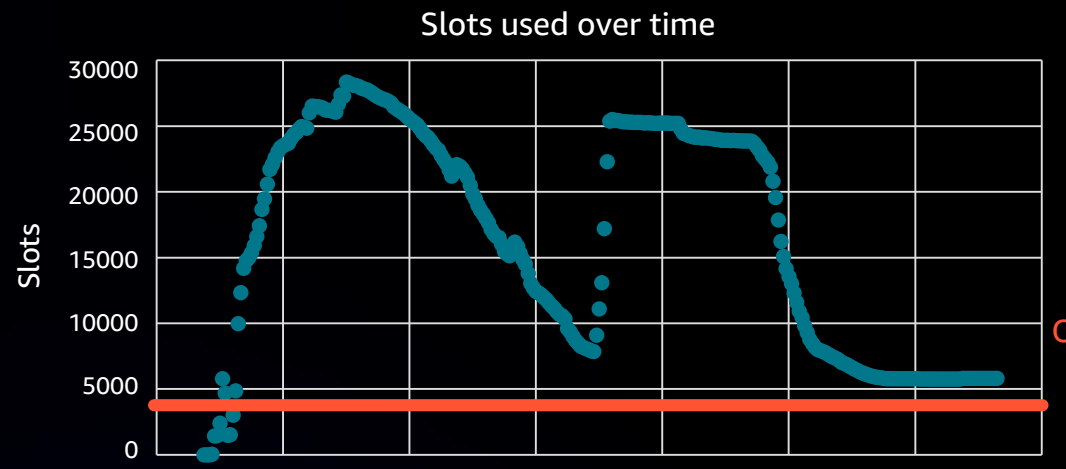
Ansys	cadence	SIEMENS	SYNOPSYS
• APLDI	• Liberate Trio • Spectre Simulation Platform • Spectre XPS	• Solido	• PrimeLib • SiliconSmart • FineSim

Benefits

- Able to address peak CPU need
- Increased productivity of engineering teams by drastically improving our turnaround time

Benefits of cloud

Paradigm shift: Move from being CPU limited to becoming human limited



4,000 slots for <4 month

20,000 slots for <1 month

Cost
Run time

Scalability
Efficiency

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Hardware IP verification in the Arm Cloud



- Cortex M55 is Arm's first CPU project to move to the cloud – also first to find bugs using Arm architecture servers
- Cloud migration began before Graviton was released – about 30% of validation in first pre-release phase moved to cloud, contributing to a significant increase in test cycles run and so higher product quality while still hitting the release schedule
- Moving to Graviton2 increased simulation performance by 19.5%
- Over the past year, **36 million** CPU hours have been spent on M55 validation in the cloud

"AWS has given us the scalable verification bandwidth needed to give us confidence in our core. Moving verification soak runs to Graviton2 has proven to be highly effective for our workloads as well as fulfilling a long running goal of designing Arm processors on Arm processors."

Yashi Bateja, Lead Validation Engineer, Cortex M55



After the switch to Graviton2, the nightly Cortex M55 test suite completed before engineers got in the next morning

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For a company well known for its hardware IP, Arm does a lot of software engineering

arm KEIL STUDIO

arm DEVELOPMENT STUDIO

arm ALLINEA STUDIO

arm SOCRATES

Different classes of software bring different challenges

- Embedded
- Tools and models
- Ecosystem open source
- Engineering infrastructure

Agility is the common characteristic across all classes of software development

- CI/CD
- Prototyping & experimentation
- Workload characteristics

AWS Cloud's versatility ably matches our requirement for a platform that can support this need for agility

arm MALI

arm FORGE

arm FAST MODELS

arm COMPILER



LLVM

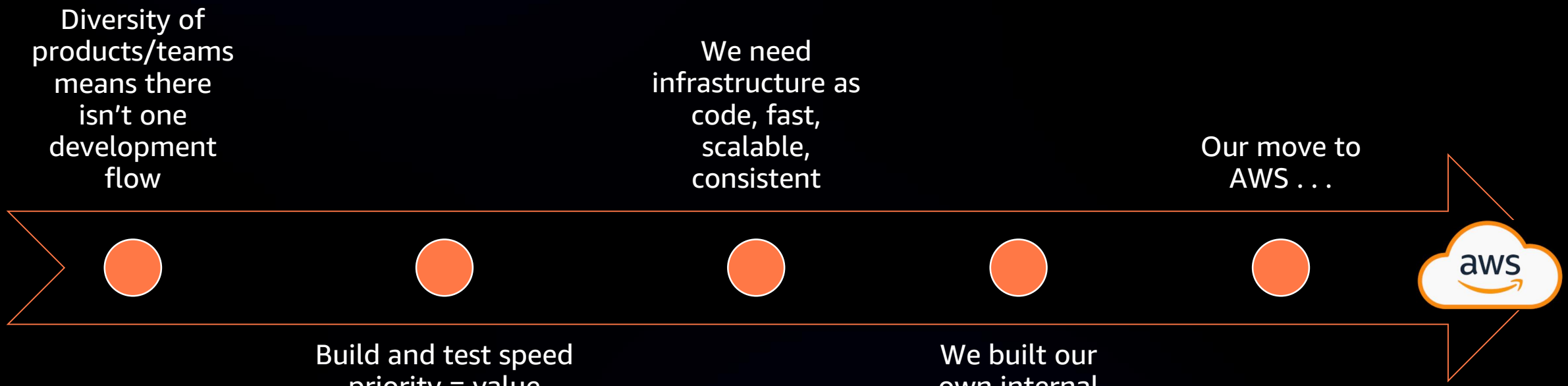


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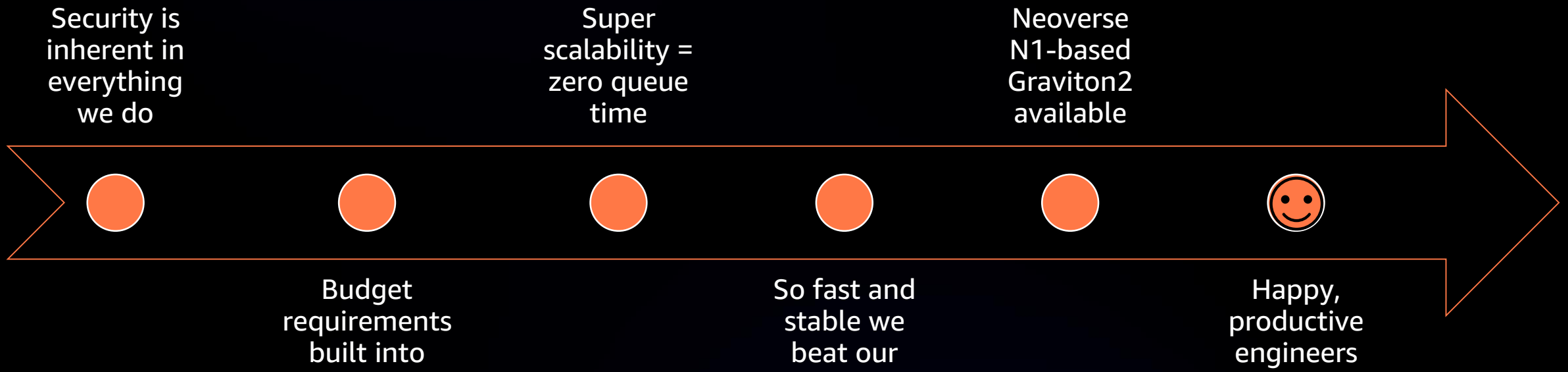
Development Solutions Group (DSG) – Build and test

DSG MAKES COMPILERS, MODELS, AND DEBUG SOFTWARE TOOLS TO SUPPORT THE ARM IP



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Results!



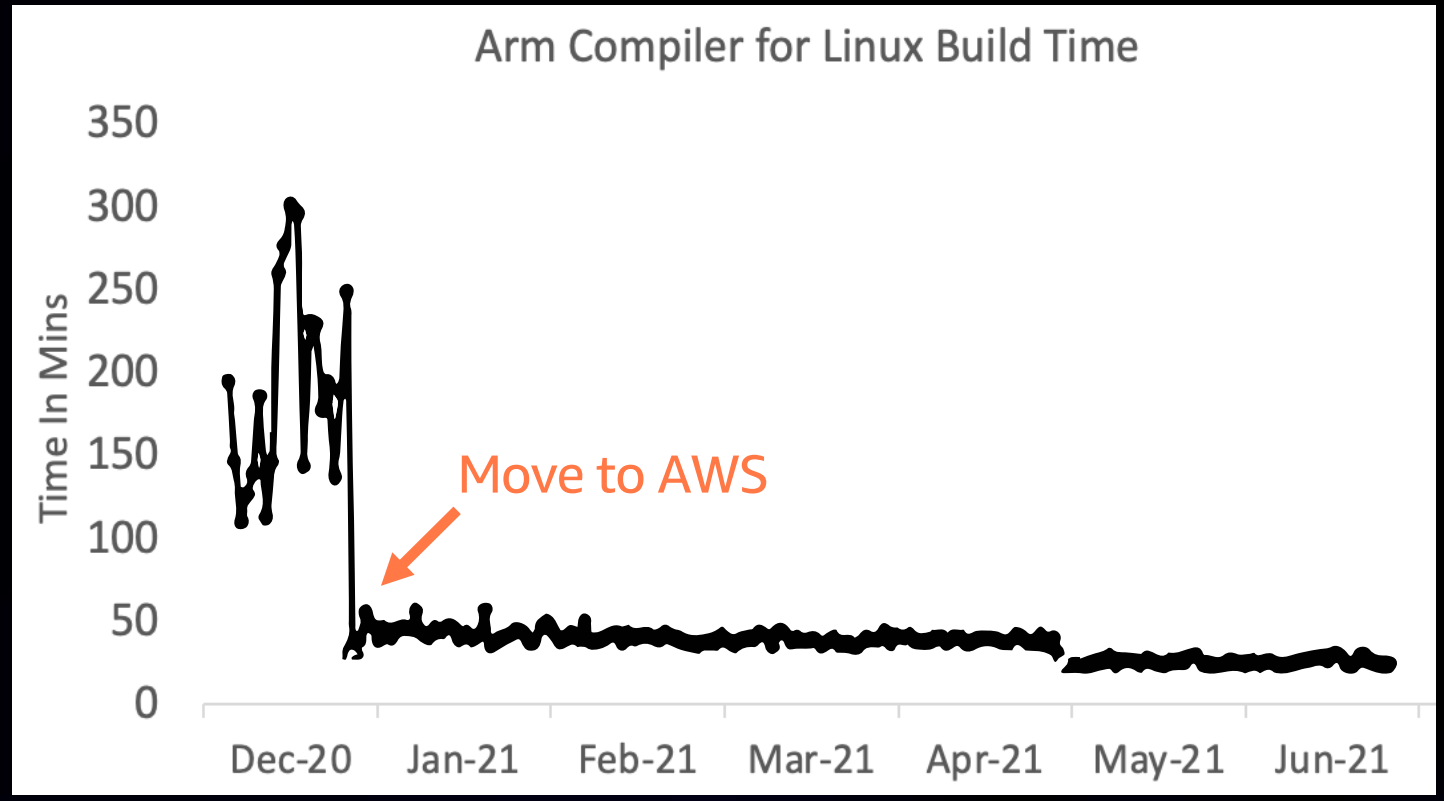
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Arm Compiler for Linux

ARM'S HPC COMPILER FOR SUPER-COMPUTING

Built and tested on AArch64 only

- Pre-AWS
  - Average build time was 3 hours and 9 minutes
  - Worst outlier was 5 hours
- AWS
  - Average time on AWS is 15 minutes
  - Fastest runtime is currently 13 minutes and 40 seconds
  - Queue time = 0



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Journey to the Arm Cloud summary

- Running Arm EDA on Arm Neoverse-based AWS Graviton2 instances has resulted in massive benefits to our IP delivery business
  - Significant cost savings over x86-based instances
  - Reduced runtimes and improved performance
  - Jobs just run – no queues or resource constraints
  - Greatly improved workload throughput
  - Happy, highly productive engineers able to focus on product delivery
- The EDA partners and tools ecosystem is ready for Arm
- Arm is here to help and share our lessons learned

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Wrap-up

https://aws.amazon.com/manufacturing/product-design

https://aws.amazon.com/industrial/engineering-design/

https://aws.amazon.com/semiconductor

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Thank you!

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