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re:Invent
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PRT327

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Design patterns for distributed client server systems via IoT

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About Trend Micro: Cybersecurity for 30+ years

- 500,000+ commercial customers in 200+ countries, including 9 of the top 10 Global Fortune 500
- 7,000 people passionate about security across 65 countries
- AWS Advanced Technology Partner and AWS Marketplace Seller
- 15 AWS Competencies and Service Ready Designations
- 2022 Global Partner of the Year – AWS Marketplace



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Problem to solve

- Modern scalable cloud networking for client → server communications
  - Agent provisioning/authentication overhead
  - Bidirectional data transfer in near real-time
  - Multiple transfer patterns needed
- Scalability and manageability
  - Support for 100M agents
  - Didn’t want to manage fleets of Amazon EC2 + Elastic Load Balancing (ELB)
- Easy to integrate into our current agent for transitional period
  - Over 50M agents today will need to upgrade/update
- Enable business to run faster

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Why did we have these problems?

- More data moving to the cloud – Telemetry, events, EDR, etc.
  - Longer connection times for transfer, more frequent connections
  - 1:1 data transfer needed, but not efficient for some common data patterns
- Run faster – More Dev less Ops
  - Not efficient/cost effective to scale ops team linearly to growth
- SaaS growth
  - Aggressive growth pushing limits of original designs – Database schema design, etc.
- Existing mature business
  - Customers upgrade agents in different cycles/timelines
- Endpoint is the front line for security

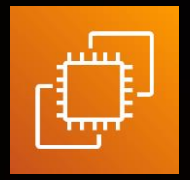
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Original

Monolith
(AWS + On premises)



Config &
event data





Client/server device

Limitations

Monolithic application
- Can’t run fast
- Database table locks at scale
- Everything must go through the core application

Fleets of Amazon EC2 + ELB for inbound connections
- Scalability – Both connection count and data volume
- Manageability

Data transfer pattern
- Only supports 1:1

Agent provisioning/authentication
- Part of the monolith

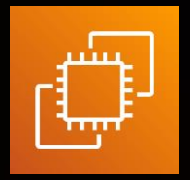
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Original

Monolith
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Config &
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Client/server device

Today

SaaS hybrid (AWS)



Config data

70+ pools of Amazon EC2 instances today





Event data

Handle large volumes of event data upload



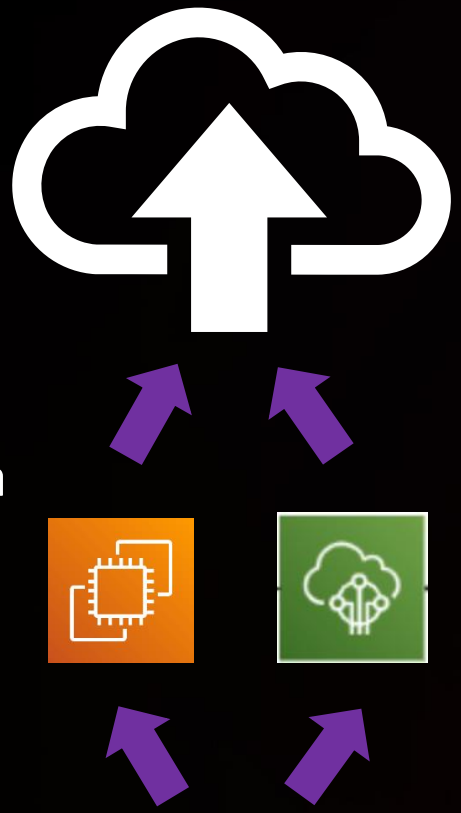
Client/server device

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Today

SaaS hybrid (AWS)



Config data

70+ pools of Amazon EC2 instances today

Event data

Handle large volumes of event data upload

Client/server device

Wins

- Existing agents = Stable
- Significantly limited creation of new Amazon EC2 pools
- Use existing channel to set up new IoT channel
- Enables M:1 data transfer pattern
  - Offload a lot of data upload to new IoT channel

Limitations

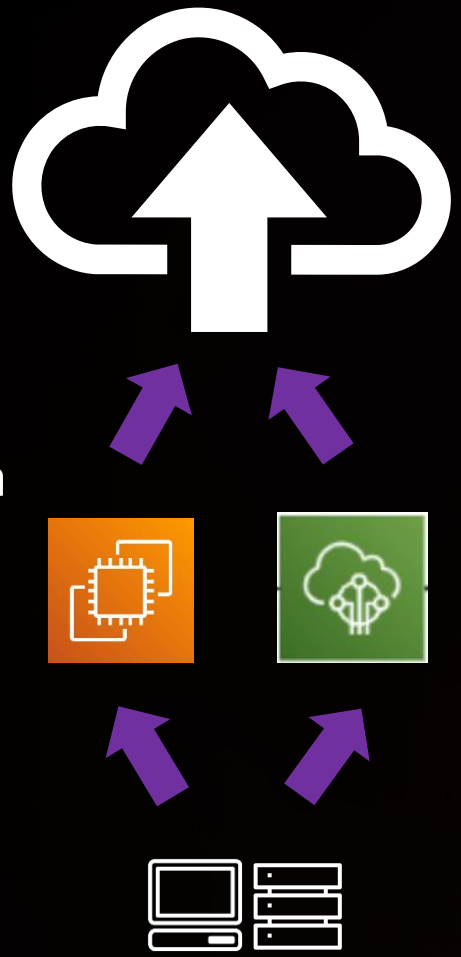
- Still must manage a lot of Amazon EC2 pools
- Monolith smaller, but still contains dependencies in application structure for DB access

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Today

SaaS hybrid (AWS)



Config data

70+ pools of Amazon EC2 instances today

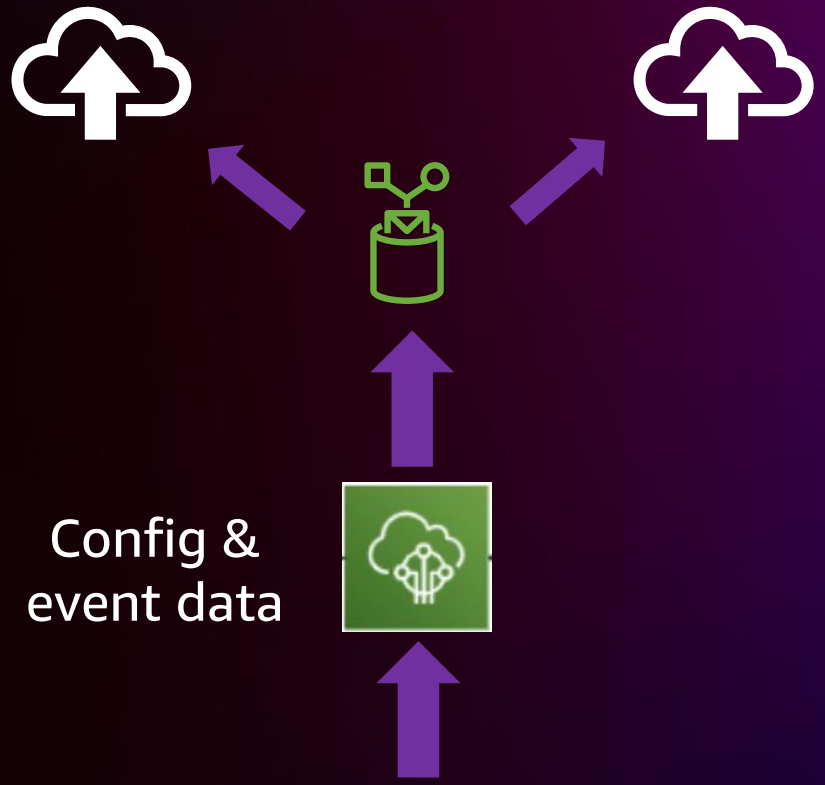
Event data

Handle large volumes of event data upload

Client/server device

Goal/plan

SaaS microservices (AWS)



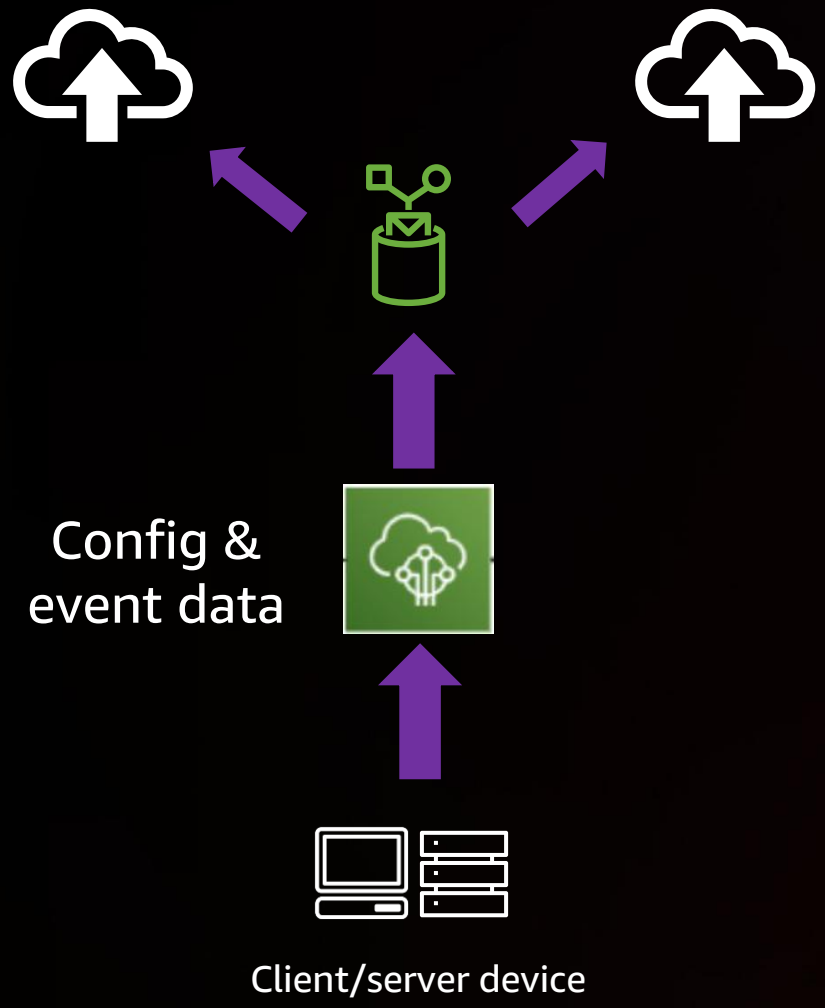
Config & event data

Client/server device

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Goal/plan



Why?

- Amazon EC2 fleets gone!
- Reduces FQDN's needed for agent comms
- Route traffic/messages via IoT rules engine
- Agent jobs not dependent on agent connections
- Agent authentication outside the application
- Supports multiple data transfer patterns
  - 1:1, M:1, 1:M

Challenges we handle

- Agent reactivation/cloning
- Offline agent message queueing/retry
- Large file transfers (>128 kb)

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Why AWS IoT?

- AWS handles scaling/agent-server retry, connection security, etc.
- Enable internal teams to run faster without having to worry about networking
- Communicate to multiple agents more efficiently
  - Can dispatch a task to multiple agents just by adding additional agents to destination (1:M)
  - Multiple agents can report data in at once (M:1)
- AWS IoT rules engine to route data to where needed
  - Moved routing logic out of application core monolith

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Future considerations

- AWS IoT Greengrass
  - Move some processing closer to agents
  - Limit/proxy outbound connections via 1 appliance gateway
- AWS IoT beyond agents
  - Network appliance management
  - Trend Micro’s VicOne

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AWS IoT
Supporting Edge to Cloud Innovation

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A comprehensive set of services for IoT

Security from edge to cloud



Design



Manufacturing



Edge processing

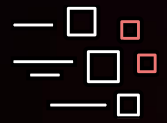
FreeRTOS
Connectivity down to a microcontroller level

AWS IoT ExpressLink
Pre-configured connectivity modules for plug-and-play designs

AWS IoT Greengrass
Deploy, process, manage, and run solutions locally on your device



Connectivity and registration



Collection and processing of data



Analysis

AWS IoT Core
Connect billions of IoT devices and route trillions of messages to AWS without managing infrastructure

Amazon Kinesis Video Streams
Capture, process, and store media streams for playback, analytics, and machine learning

AWS IoT Analytics
Run and operationalize sophisticated analytics on massive volumes of IoT data

AWS IoT Device Defender
Audit configurations, authenticate devices, detect anomalies, and receive alerts to help secure your IoT device fleet



Unlocking insights



Management & advisory



Efficiencies at scale

AWS IoT Device Management
Register, organize, monitor, and remotely manage IoT devices at scale

AWS IoT TwinMaker
Optimize operations by easily creating digital twins of real-world systems

AWS IoT SiteWise
Collect, organize, and analyze data from industrial equipment at scale

AWS IoT FleetWise
Easily collect, transform, and transfer vehicle data to the cloud in near-real time

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Offload connectivity and management with AWS IoT Core



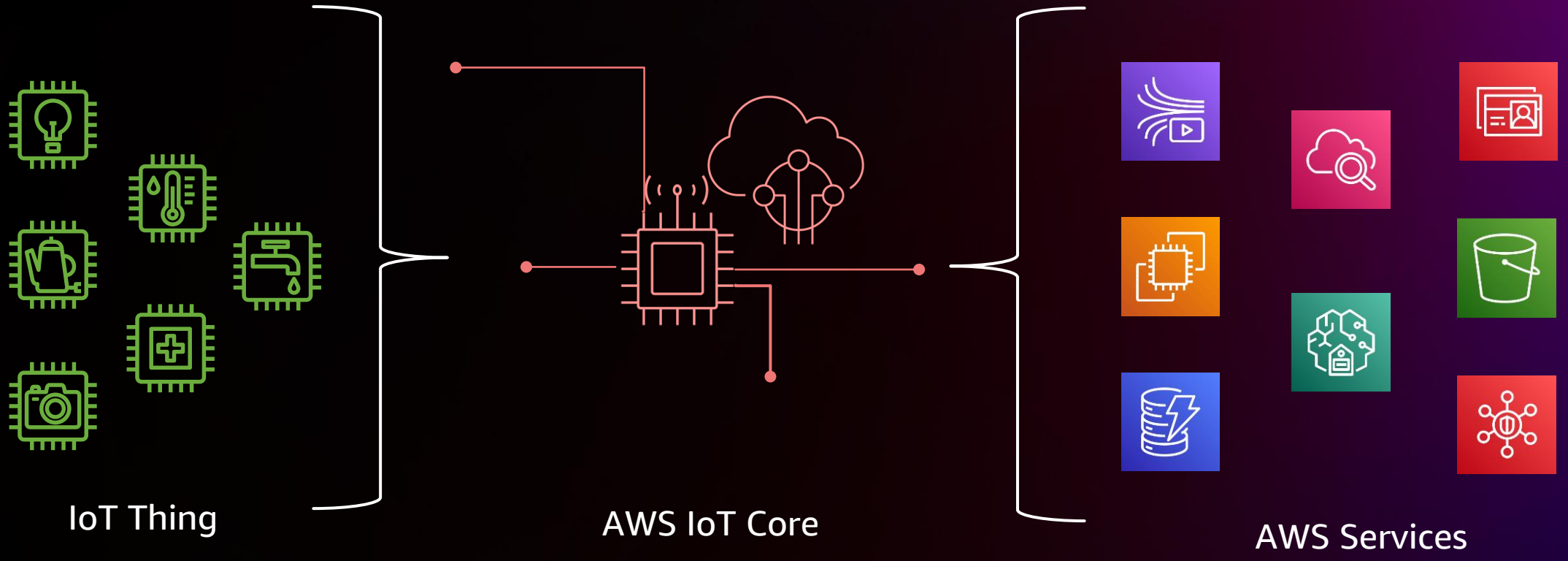
Identity service	Device gateway	Message broker	Rules engine	Device shadow	Registry	Device advisor
Manage authorization of devices and provision unique identities at scale	Fully managed connectivity optimized for IoT workloads	Communicate across your IoT fleet reliably and fast	Ingest large amounts of IoT data at a low cost, pre-process it, and make it available to 20+ services	Understand and control the status of your device at any time	Define and catalog device for easy use by AWS services	Fully manage test capability for IoT devices

+ Specialized long-range connectivity with AWS IoT Core for LoRaWAN

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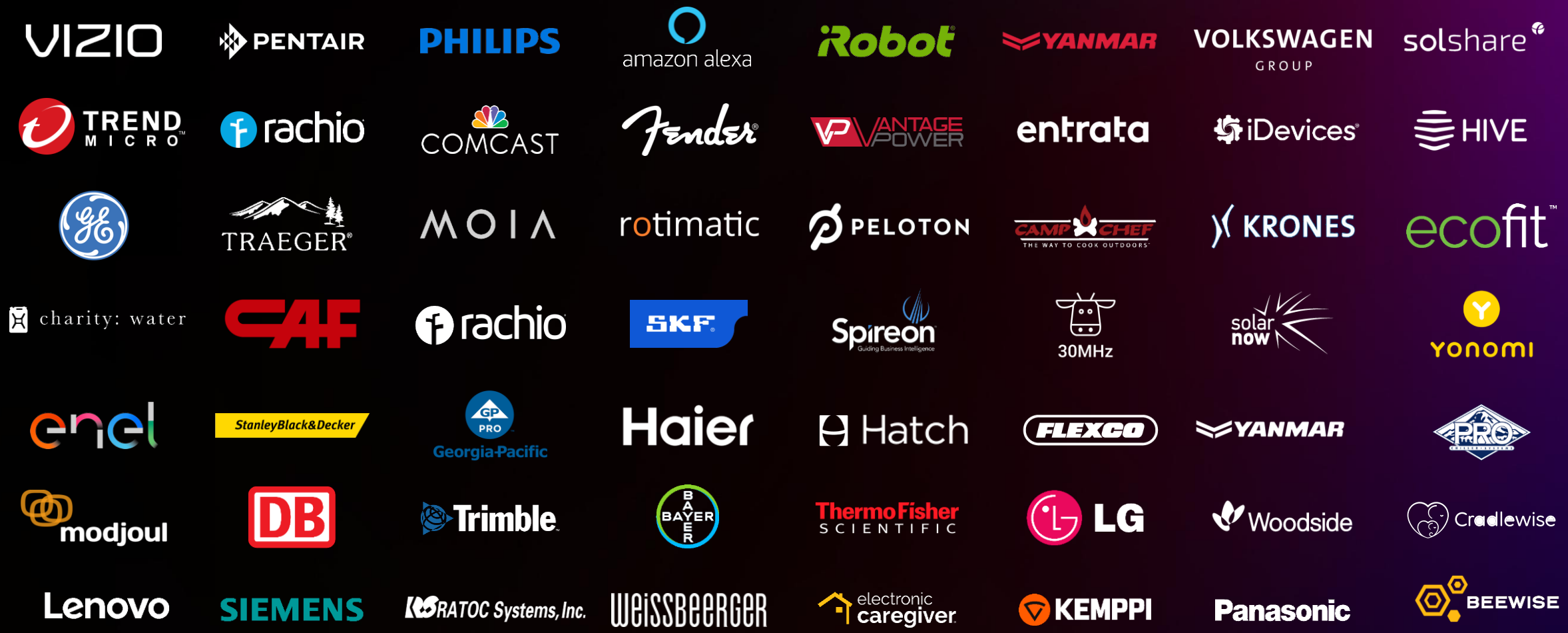
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An entry point into the world of AWS services



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Many companies are using AWS IoT to delight customers



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Differentiating through connected IoT products



Customer Experience

Use IoT data to improve customer experience



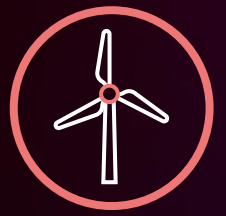
Increase Revenue

Unlock new sources of revenue



Save OpEx

Improve operational efficiencies



Accelerate Innovation

Increase your business velocity

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Where customers are creating differentiation



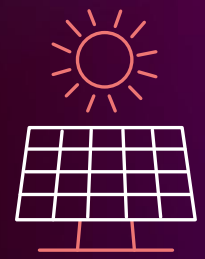
Building smarter products and user experiences in homes, buildings, and cities



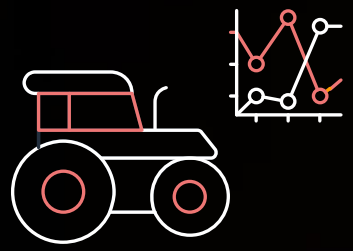
Building connected healthcare and wellness applications



Improving safety, productivity, and engagement in connected campuses



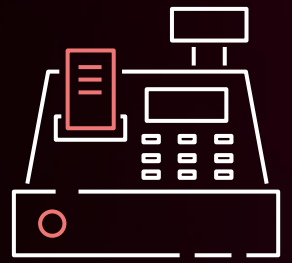
Managing energy resources (connected batteries, solar panels, and more)



Growing healthier crops with greater efficiencies



Transforming transportation with connected and autonomous vehicles



Improving shopper experience and optimize stocking programs in retail



Streamlining food planning in quick-service restaurants

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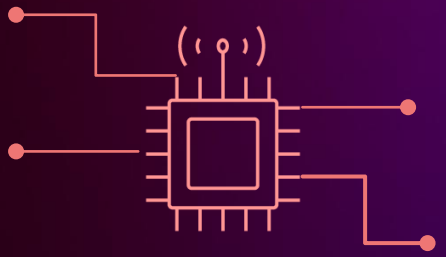
AWS IoT Impact

45B+ Messages processed every day	**99.9%** Service Level Availability for all IoT services	**45+** AWS IoT Competency Partners
500+ AWS IoT offerings in the AWS Marketplace	**800+** Qualified HW Partner devices	**35+** Service updates in 2022

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So, what is a “device” anyway?

- Traditional IoT devices are different from servers, laptops, mobile phones
  - Constraints – memory, CPU, power, bandwidth, latency, continuity of connectivity
    - Leads to custom protocols, authentication, security
  - Single purpose and often highly customized
    - Deep integration from edge to cloud, and support for various hardware systems
- We solved for these challenges with AWS IoT Services



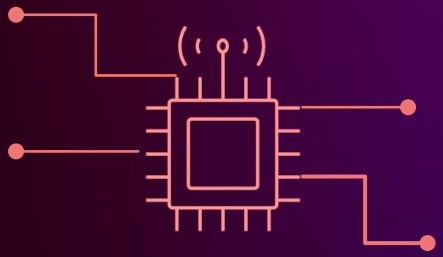


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Applying IoT technologies to “Virtual” Things

- These same technologies give us powerful tools for other domains
  - Stream telemetry data and command/control between “virtual” things (agents) and the cloud
  - Publish/subscribe models allow decoupling producers from consumers
  - MQTT enables lightweight control channels
  - Rules engine allows easy integration with other AWS services
  - Custom authentication schemes allow difficult enterprise trust relationships





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Architectural Patterns to unlock Innovation and Scale

- Decouple clients and applications, accelerating delivery velocity and innovation
- AWS IoT abstracts the “network” up to the application layer
- Add new clients and let AWS handle scaling and elasticity
- Easily adopt best practices in security, error handling, and take advantage of high reliability
  - AWS IoT Core
  - AWS IoT Core Device Advisor
  - AWS IoT Device Defender Audit



Improved Scale & Elasticity
45B+ messages processed daily

High Reliability
99.9% Service Level Availability for AWS IoT services

Enhanced Security
Achieve a high level of security without building own security infrastructure

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Thank you!

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