Observations from the Edge

The evolution of Hybrid Cloud



Rob High

IBM Fellow, Vice President CTO Software Networking and Edge Computing Retired

In the beginning ...



Mainframe Era (circa 1960s) Centralized Computing







Client-Server Era (circa 1980s) Distributed Computing







Web Computing Era (circa 2000s) Centralized Computing



Netscape announces the first open, cross-platform "digital envelope" protocol, to be supported by Intuit, MasterCard, and others.

WINDOWS 95 NAVIGATOR BETA Download the latest beta release of Netscape Navigator, specially tuned to take advantage of Win 95 interface enhancements and features.





Mobile Computing Era (circa 2007) Distributed Computing







Cloud Computing Era (circa 2010s) Centralized Computing







Hybrid-, Multicloud Era (circa 2020s) Distributing the Centralized Computing







Edge Computing Era (now) Distributed Computing











Example Edge Devices / Servers / Clusters/ MECs



Eurotech - BoltGATE 20-31



HP Retail Solutions



Atos BullSeguana Edge Server



Dell PowerEdge Servers



ABB Industrial Robots



Schneider Electric Intelligent Power Control



Intel NUC



AD Link Neon-2000-JT2 GPU-enabled Intelligent Camera



Samsung XCover Pro



Scale Computing Hyperconverged Edge Appliances



Daimler Connected Vehicles





Smartcone Solutions



Advantech Edge IoT Gateway

Why the pendulum?



IT is a fashion industry



Scaling growth requires distribution





People want to make decisions better and faster.

You want to minimize your data operations costs.

Your personal and private information should be protected.

You should be able to continue to operate your business, even when the network is down.

The principle of distribution applies to computing as well Both inherently, but mostly driven by the need to support work

Edge Computing ...



What are the edges of edge computing?



Management challenges at the Edge

While the edge leverages cloud-native development practices, the edge is not the cloud

1,000x

Edge computing at scale

Cloud computing



thousands of heterogenous servers & devices in thousands of remote locations with thousands of locations, servers & devices continuously added Lots of homogenous servers in Few data centers With minimal change to the server environment

Massive scale, variability and rate of change requires autonomous management

IBM Edge Application Manager (IEAM)



IBM® Edge Application Manager - IEAM securely manages **getting the right workload to the right place at the right time** and keeping it up to date in edge computing topologies.

IEAM provides security, flexibility, scalability, and policy driven autonomy.

You can deploy, update and retire <u>applications</u> *and* <u>AI/ML model</u> at scale.

A single management hub can manage 40K edge nodes.

Use cases in every industry





















Boston Dynamics' Spot™ Quadra-ped Robot



Spot is an agile mobile robot.

- Navigates terrain with unprecedented mobility allowing companies to automate routine inspection tasks and data capture safely, accurately, and frequently.
- Base platform provides advanced mobility and perception to navigate while collecting 2D and 3D information with on board-sensors.
- Adding payloads enhance Spot's sensing and data processing capabilities.

Fire Extinguisher Inspection



Key benefits:

With AI, operationalizes data collection, analysis and action.

Detects problems humans could miss.

Consistent data collection = robust AI models.

Performs the dull, dirty, dangerous inspections.









Samsung Industrial Mobile Devices



MIL-STD-810G and IP68-rated

• Critical for use industrial, chemical, and field industries

Network enabled

• LTE, 4G, 5G, 802.11 a/b/g/n/ac/ax Wifi, Bluetooth, GPS, Private-LTE (CBRS), POS-Ready NFC

Secure

• Knox-based security policies, kernel protection, hardware root of trust, trusted boot

Instrumented

• Sight, Sound, Location, Direction, Altitude, Acceleration / Vibration / Shock, Temperature, Humidity

Human Augmentation



The Intelligent Human Edge

"We envision a workplace where smartphones will augment workers by enhancing their productivity and deliver intelligence at the edge, empowered by emerging technologies and cloud native applications"





Tapping in the Cloud-native Developer community for mobile-edge computing

iOS and Android Developers¹

- $\sim \frac{1}{2}$ Million focused on Enterprise Solutions

Cloud-native Developers

• 7 Million trained and certified for building Containerized solutions

- Host on Industrial-hardened Mobile Phones and Tablets
- Leverage native compute, storage, network, camera, microphone, location, environmental, and other sensors provided on the mobile device
- Exploit the advantages of container-based workloads for isolation while maintaining a low footprint
- Enable use-cases that benefit from mobile form-factor and existing procurement processes

"How Many Mobile App Developers Are There in the World?", Intersog, <u>https://intersog.com/blog/how-many-developers-are-there-in-the-world</u>

Container Architecture on Smartphones

Faster development times for mobile apps with cloud-native architecture The ability to deploy and automate management of devices and apps at scale Improved productivity with Industry 4.0 and other use cases



Examples

Improving Warranty Issues & Embedding safety and quality into human processes

Automotive

Aerospace



- 700+ cabling connections per vehicle
- Complex, difficult cabling (car, door)
- High defects due to poor cable connections



- Unionized workforce (limited tech adoption)
- Worker Safety
- Extensive knowledge transfer / training

Pharmaceuticals



- Losses = \$200B annually to the counterfeit market
- 10% (~7B\$) of pharmaceuticals worldwide are counterfeit

Experiments with Docker Runtime on Samsung Android



Using IBM's Edge Application Manager to place a container on Samsung Android devices and run AI workloads

Implements official Rootless Docker binaries released for Linux arm64 on a Samsung Android smart phone

Modified Android Linux Kernel to include missing features needed by Docker

Can continue using the device as a normal Android phone

Mayflower Autonomous Ship



Taking the human factor out of the Mayflower has allowed us to completely reimagine the design. Instead of thinking about eating, sleeping and sanitation, the Mayflower's engineers were able to focus purely on the mechanics and function of the ship

MAS is a Hybrid Edge and Cloud Solution



The Software





Operational Decision Manager

- COLREG evaluation
- **CPLEX** Optimizer
- Solution optimization
- Maximo Visual Inspection
- Visual recognition

Watson Studio

- Analytics

IBM Edge Application Manager

- Edge workload deployment management

Weather Company Services

- Real-time and Localized weather data

Red Hat Enterprise Linux

- Onboard operating system

Reference Materials



What is edge computing?

IBM Edge Computing Whitepaper

Gartner Webinar: Meeting at the Crossroads ...

Why organizations are betting on edge computing, IBV Report

IBM Edge Application Manager

Edge computing architecture and use cases

Act on insights closer to where your data is created with edge computing

IBM Edge Application Manager documentation

Linux Foundation Edge, Open Horizon

Open Horizon: The Video Playlist

Sharpening the Edge; Overview of LF Edge

Autonomous Edge Management

Secure Device Onboarding

Worker Insights for Covid-19 with the Edge

