Building a Mobile Edge-Cloud Solving for Application Mobility

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EXECUTIVE SUMMARY

- **What?** We are a *Deutsche Telekom-founded company* that has been operational since January 1, 2018.

- **Where and Who?** We’re headquartered in “Silicon Valley” and run by a globally experienced, multi-disciplinary team that have been responsible for leading inventions in clouds and mobile networks.

- **Why now?** Mainstream operator investments now include the building of accessible infrastructure (“clouds”).

- **Why?** We believe that *edge is the missing piece* in a *new value chain* that expands the types of devices on mobile networks, secures IOT, makes possible next generation content (AR/MR), readies mobile infrastructure for large scale handling of video ingress along with computer vision and machine learning services which are needed for autonomous devices.

- **How?** We do this through open source software and a new business and operational model where we aggregate highly distributed operator infrastructure on a global scale and deliver normalized, abstracted interfaces to application developers and device makers. We allow for unique access to previously inaccessible assets with mobile operator infrastructures.

- **Who is it for?** Our customers are application creators and device makers.
Problem Statement and Business Opportunity
Current State

**DEVICES**

- 3.7 billion devices

**NETWORKS**

- 1.7 Trillion USD CAPEX last 10 years
  - (mainly used as bit pipe)

**CLOUD**

- 300 Billion USD CAPEX last 10 years
Emerging new class of applications
Pervasive and Immersive

Yesterday
- Device: PC
- Interaction: Web based
- Content: Primarily static

Today
- Device: Smartphones/Tablets
- Interaction: Web/App based
- Content: Increasingly video

Tomorrow
- Device: Smartphone/Tablets, IoT, Next-gen (Glasses, Drones)
- Interaction: AI based, Natural Interface, Machine
- Content: Video heavy, Interactive, Latency sensitive, High IO

π apps will be cellular native and bandwidth/computation intensive

π apps = PI = Pervasive & Immersive

Introducing an emerging class of applications …
Client is mobile – Cloud is static

Static and geographically distant cloud
Client has become mobile but backend is still location unaware and static
Bringing cloud closer to device
Make backend mobile - based on User’s verified Identity and Location

MobiledgeX Edge-Cloud Software Benefit for Operator
Independent Edge

- Applications gets deployed in public cloud as before
- MobiledgeX control plane automatically scales applications from public cloud to appropriate cloudlets based on a user’s verified identity and location by integrating an operator’s OSS/BSS system
- Offers a per country architecture addressing country specific data privacy laws while offering a global marketplace in a single pane of glass to developers
Business Solution
**UNTAPPED OPPORTUNITY – OPERATOR EDGE**

**Four Sites of Computing**

1. **Embedded (Local) Compute**
   - **Client / Smart Device**

2. **Centralized Cloud**
   - **Deep Network**

3. **On-Site Edge**
   - **Connectivity**
   - **Locations**
     - **Connected / Autonomous Car**
     - **Smart Home / Building / Factory**

4. **Near Edge / Operator Edge**
   - **Connectivity**
   - **Locations**
     - **Virtualized Regional Data Centers**
     - **Traditional In-Cloud Compute**

*Edge Computing* is defined as any compute functions that occur between the device (client) and the server (static, centralized back-end).

*MobiledgeX’s focus is the untapped ‘Near Edge’ opportunity.*
Preparing for future state - “Day Zero”

DEVICES

2012 Handset – 76 Gflops
2017 Handset – 600 Gflops
2018 Handset – 5 TFlops

NETWORKS

AWS CC2 – 333 Gflops
AWS P3 – 1 PetaFlops
Google TPU – 11.5 PetaFlops

Should the network provide more than just connectivity?
Wanted Consumption Model

Device Native | Zero Touch | Cloud Native

DEVICES | NETWORKS | CLOUD

STANDARD SAAS MODEL | STANDARD CLOUD CONSUMPTION MODEL

Cloudlet
Managing Privacy
Federated Distributed Planet Sized Kubernetes

Creating services using devices, networks, clouds as one global entity with federated policies and local compliance

**Distributed Federated Global Control Plane:**
Global required data – Developer enablement, introspection, settlement, developers, global policies, applications registry

**Distributed Zonal Control Plane:**
Country required data – local policies, devices/users, compliance, governance

**Cloudlet Assurance, Integrity and Governance:**
Operational required data – device specific data, status, instantiation, performance, usage,
MONETIZATION STRATEGY

Edge Services Marketplace
Developers and Device-makers get access to a curated set of Edge services developed by 3rd parties and hosted/managed via MEX

Example: Unity plugin, SDKs and basic services for edge for use by other game developers

Network Data & Enhanced Services
Applications can access unique network metadata available due to MEX operator integration and accompanying MEX services built on top

Example: OEMs using MEX-developed Predictive QoE and Dynamic grouping for Autonomous swarms

Edge Infrastructure Access
Developers and Enterprises can host their own complete/partial apps on the aggregation enabled by MEX, thereby extending their cloud to the Edge

Example: Niantic hosting their Occlusion feature on the Edge for their own games

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Technical Solution
MobiledgeX Edge-Cloud

DEVICES

Native Device Support

NETWORKS

Distributed Matching Engine

APIs

SDKs

EDGE-CLOUD CONTROLLER

Cloudlet Resource Manager

Cloudlet Compute Resources

PUBLIC CLOUD

CLOUD

DISTRIBUTED FEDERATED PLANET SCALE KUBERNETES
Key features of Edge-Cloud

• Bringing Cloud Closer to Devices

• Temporal Location Based Grouping

• Federated, Distributed, Global Scale Application Container Orchestration

Edge-Cloud Offers a per country architecture for addressing country-specific data privacy laws while offering a global marketplace and single pane of glass to developers.
### Device enablement – Operator independent

<table>
<thead>
<tr>
<th>Device Enabling Layer &amp; SDKs</th>
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<tbody>
<tr>
<td>Android SDK</td>
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<tr>
<td>IOS SDK</td>
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<tr>
<td>C# SDK</td>
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<td>C++ SDK</td>
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<tr>
<td>Unity SDK</td>
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<td>HTML/JS SDK</td>
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**Gray boxes are uncommitted roadmap.**
**DEVELOPER COMMUNITIES & OPEN LABS**

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<tr>
<td>THE LINUX FOUNDATION</td>
<td>To consolidate disparate industry edge initiatives.</td>
<td>To drive innovation, financial performance and efficiency in all aspects of telecom infrastructure.</td>
<td>DT initiative to accelerate 5G and edge customer understanding and adoption potential.</td>
<td>Academic partnership and consolidation of industry players to best understand what is possible/needed.</td>
<td>Certify vendor infrastructure configs that can then be delivered with industrial scale and cost.</td>
</tr>
<tr>
<td>MobiledgeX</td>
<td>To drive the correct approach, delivery and industrialization of a distributed federated control plane.</td>
<td>To ensure accessibility and maximum utilization potential from the perspective of market demand.</td>
<td>To get early market access to potential demand and needs and ensure delivered edge services meet those needs.</td>
<td>Access and participation in edge computing knowledge, value, learnings.</td>
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Current Market Status
Live in production in Germany

World's First Public Mobile Edge

Introducing MobiledgeX Edge-Cloud R1.0

MobiledgeX Edge-Cloud R1.0 enables application containers to be deployed with the same simplicity as over-the-top, hyperscale datacenter-based cloud providers. The product powers compelling new use cases already live in networks today, including:

- Automatically deploying application backends close to users based on their Verified Location and Identity
- Augmented Reality and Mixed Reality Performance Support
- Video & Image Processing That Meets Local Privacy Regulations
MobiledgeX, Samsung, Niantic, DT

- 2,000+ visitors to multi-player AR game demo with Niantic & Samsung (#1 traffic in Deutsche Telekom’s booth)
- Executives from more than 15 operators played the game & experienced the developer console
- More than 25 articles mentioned the demo
PARTNER & MEDIA ACTIVITIES

MobiledgeX is engaging/targeting players across the Edge value chain. Many conversations ongoing which are not yet publicly disclosed.

Operators*
- Rogers
- Telefonica
- T
- Vodafone

Apps / Devs*
- SONY
- STARA
- 1000 realities
- Mapbox
- Magic Leap
- Unity
- Bosch

Ecosystem*
- Samsung
- Telecom Infra Project
- Microsoft Azure
- AWS
- World Wide Technology
- Cisco

* Logos are only representative of target or potential partners; Not fully executed/disclosed partnerships

MobiledgeX: Enabling New Immersive Experiences With Edge Computing
3/4/2019

MobiledgeX, Deutsche Telekom, Samsung and Nendo showcase the world’s first edge-enabled, multiplayer augmented-reality demo at Mobile World Congress 2018. Geoff Hollingworth, CMO of MobiledgeX, explains how edge computing supports speed and scalability challenges to seamlessly execute edge-enabled experiences today.

World Wide Technology and MobiledgeX Partner to Validate Mobile Edge Computing Solution Readiness for Global Operator Edge Deployments

MobiledgeX & Sfara form a Global Technology Partnership
Addressing Driver Analytics and Mobile Assurance Services for the Reinsurance & Insurance Industry arising from the introduction and ongoing development of semi-autonomous and fully-autonomous Level 3 through Level 5 automotive, trucking, transportation, mobility, fleet management and ride sharing services.

MobiledgeX Revs Up & Shifts Into Gear

BERLIN — Edge Computing Congress 2018 — Only nine months after its launch, startup MobiledgeX has unveiled its suite of edge computing tools designed to bring third-party application developers on board generation networks, outlined its open source plans and ramped up their operator charm offensive in an effort to get the entire carrier community behind it by Mobile World Congress 2019.

The Deutsche Telekom AG (NYSE: DTE)-backed startup is focused on what is effectively a middleware platform that will enable third-party developers to run their applications on edge computing platforms. Part of its plan is to

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Benefits for the whole community

**DEVICES**

- Easier

**NETWORKS**

- New Revenue Streams
- Cloudlet

**CLOUD**

- Distributed Scale Faster

Developers have predictable access to unique edge resources and services

Faster Infrastructure modernization for Technology Suppliers
Thank You!