



5G-DIVE

EDGE INTELLIGENCE FOR VERTICAL
EXPERIMENTATION

Carlos Guimarães, Milan Groshev
(UC3M)

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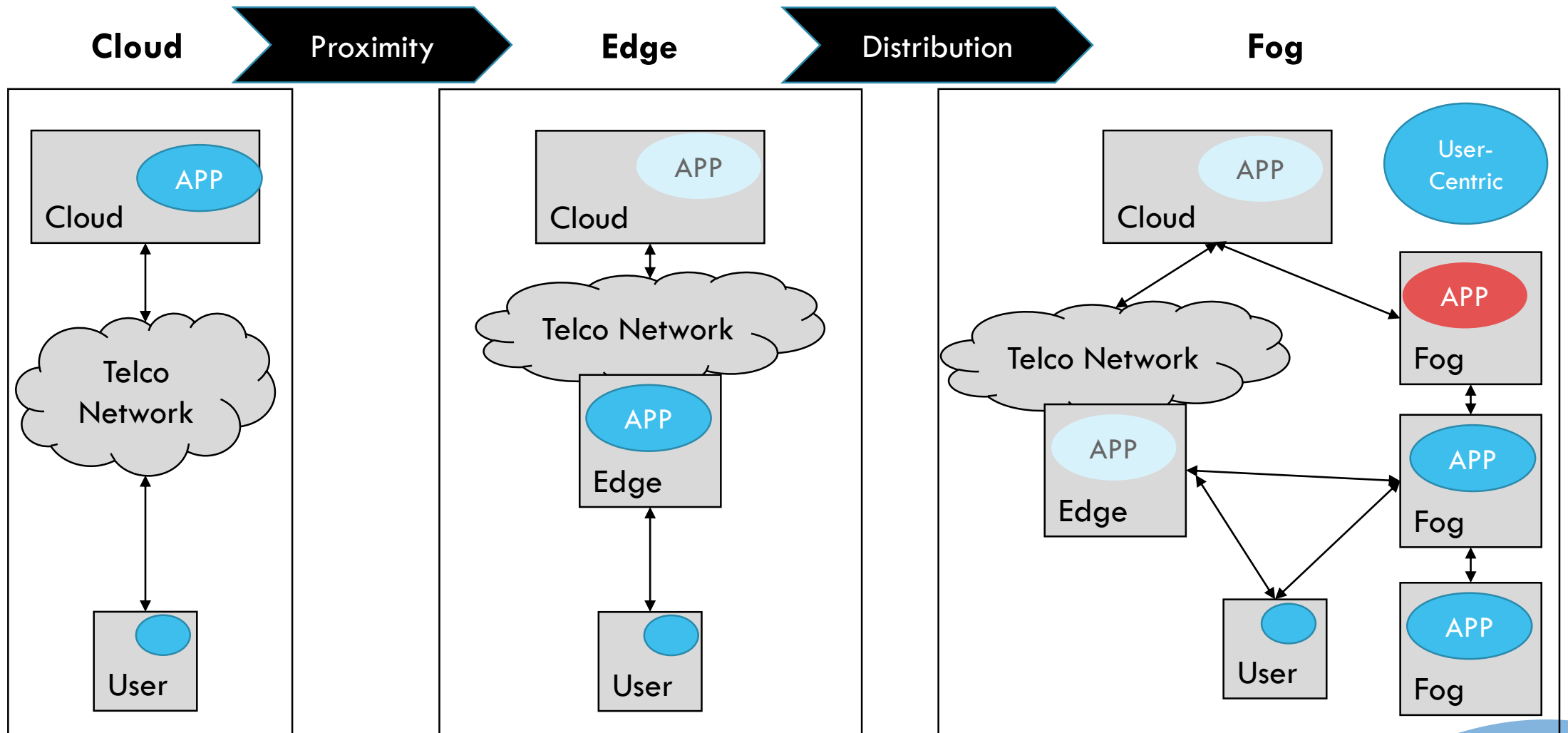
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Introduction

Edge and Fog computing

- Edge and Fog is **Logical** and refers to an overall **distributed** system
- Extends cloud computing concepts towards the edge of the network as well as to the **Extreme Edge** closer to/including user terminals
 - Examples of Fog nodes at the extreme edge are UEs and CPEs: smartphones, vehicles, robots, drones, set-top-boxes, TV units, cameras, VR/AR units, access points, etc
- At the Extreme Edge, a fog node may be:
 - **Heterogeneous** i.e. different features and interfaces
 - **Volatile** i.e. appear/disappear intermittently
 - **Mobile** i.e. on the move
 - **Constrained** i.e. limited capability (computing, storage, networking)
 - Belong to **different owners** (not exclusively telco operators)

The Cloud, Edge and Fog



Key Potential Benefits

Lower latency, higher efficiency, pooling gains, lower cost, flexibility, scalability

- **All the benefits of decentralization** in terms of proximity (lower latency), offloading (power saving, faster execution), and processing the data locally (congestion avoidance)
- **Maximize the utilization** of all computing, networking and storage resources available locally in the RAN thanks to virtualization, abstraction and pooling
- Improve 5G RAN area spectral efficiency by enabling **optimized interworking between the multiple RATs** in the RAN
- **Promote cooperative** on-demand networking and computing
- **Lower deployment cost and time** thanks to the densification of constrained Fog devices and automated orchestration and control
- **Improve flexibility** in support of different topologies and **ease scalability** (up and down) through pluggable/detachable Fog nodes
- **Open the value chain** for more stakeholders including end users to participate in the solution as providers (towards incentives)
- **Relax dependencies** on sophisticated infrastructures (e.g. in out-of-coverage) leveraging local networks and resources

Artificial Intelligence / Machine Learning

- AI will bring smart automation and (almost) zero touch configurations into computer networks
 - Instead of programming step-by-step instructions or static pre-defined set of rules, with AI we expressed the goal to achieve!
- Analyse and mining a big amount of data in order to infer valuable and enhanced knowledge from it
 - Forecasting / prediction of events
 - Finding hidden patterns
 - Detect anomalies and security breaches
- Learn behaviours by trial and error



Key Potential Benefits

Smarter decisions, more automation, improved efficiency, dynamic adaptation, event prediction and forecasting

- **Minimize the need for human intervention** and **maximize automation** by enabling entities can take decisions by themselves
- Make **smarter decisions** by leveraging a huge amount of information from different entities
- Enable **event prediction and forecasting**, a key aspect to trigger preventive measures that could avoid downtime of the network services
- **Improve the efficiency** of computer networks by making an optimal usage of available resources at each moment in time
- **Ease scalability** (up and down) through a **dynamic adaptation** of network services to face (unexpected) networking and computing demands
- **Lower operational cost and time** thanks to the automation of procedures

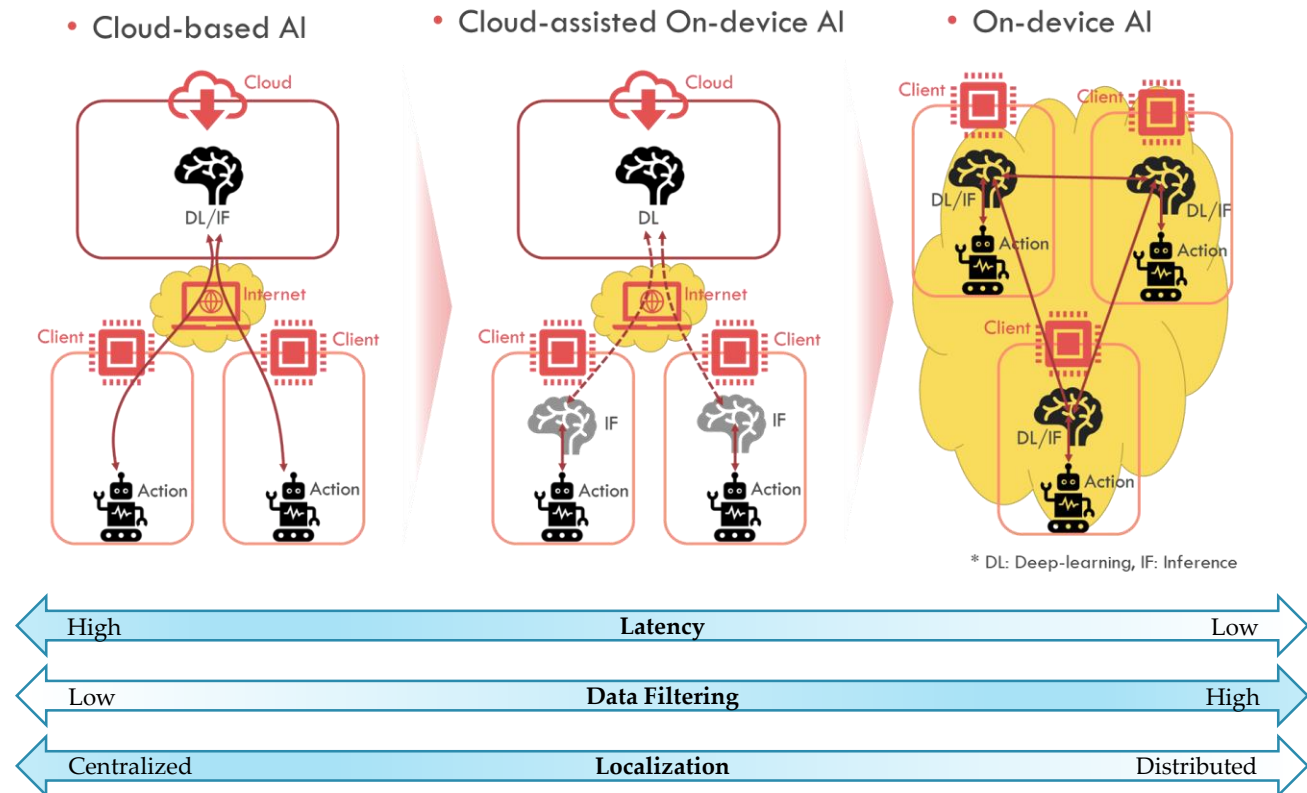
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eDge Intelligence for Vertical Experimentation

5G-DIVE Project Vision

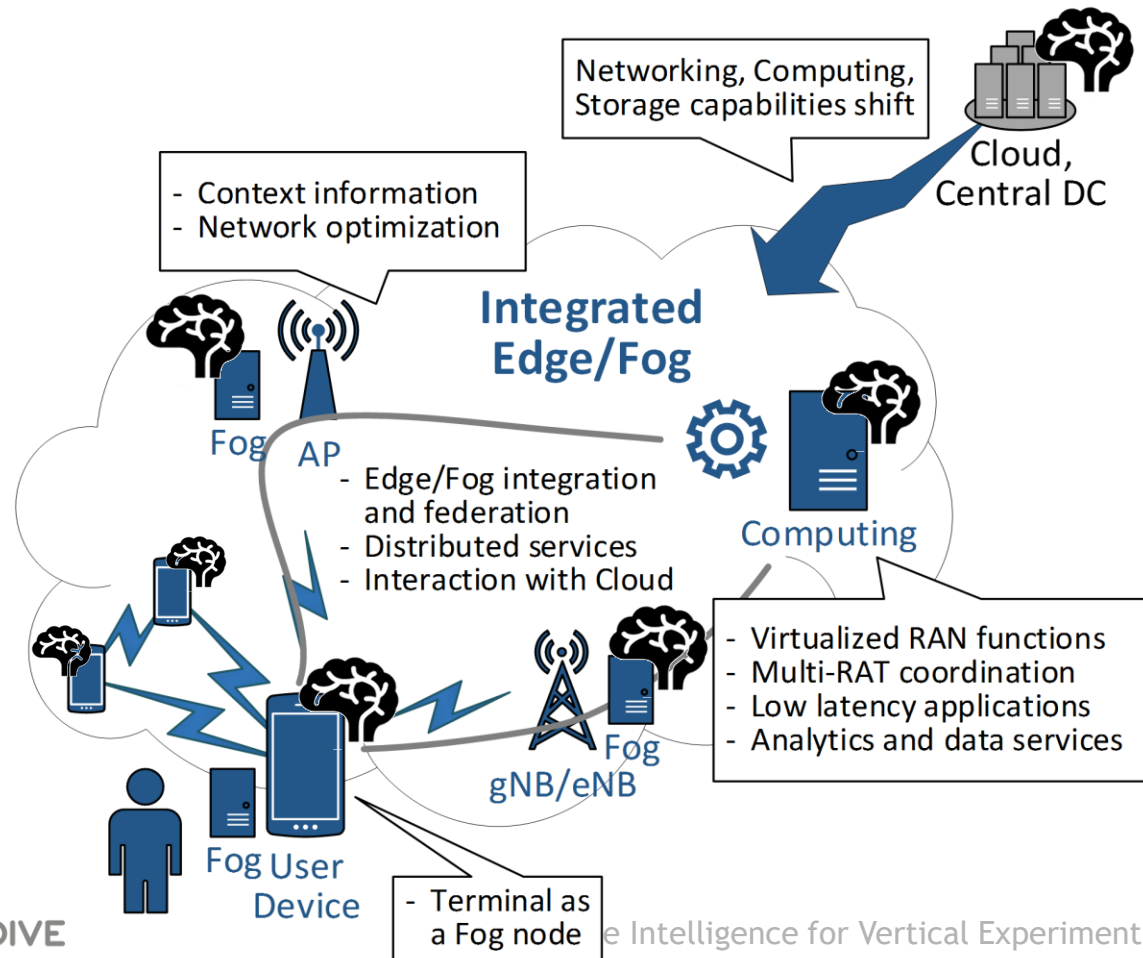
The computing fabric is no longer only centralized in the cloud but pervasively distributed through the Edge and Fog, opening new possibilities to the integration of intelligence located closely to the user.

- There is a diverse set of terminal types which all have computing capabilities ready to be harvesting
- Edge and Fog are complementary, and jointly together will define the computing substrate of next generation radio access networks
- Distributing AI towards edge and fog devices will allow more tuned automation and dynamic adaptation



5G-DIVE Project Mission

Targets end-to-end 5G trials aimed at proving the technical merits and business value proposition of 5G technologies



Mission: Design, validate and verify an intelligent 5G solution that integrates 5G connectivity with edge and fog computing (and intelligence residing on this new distributed edge)

5G-DIVE Initial Concept

(1) EFS:

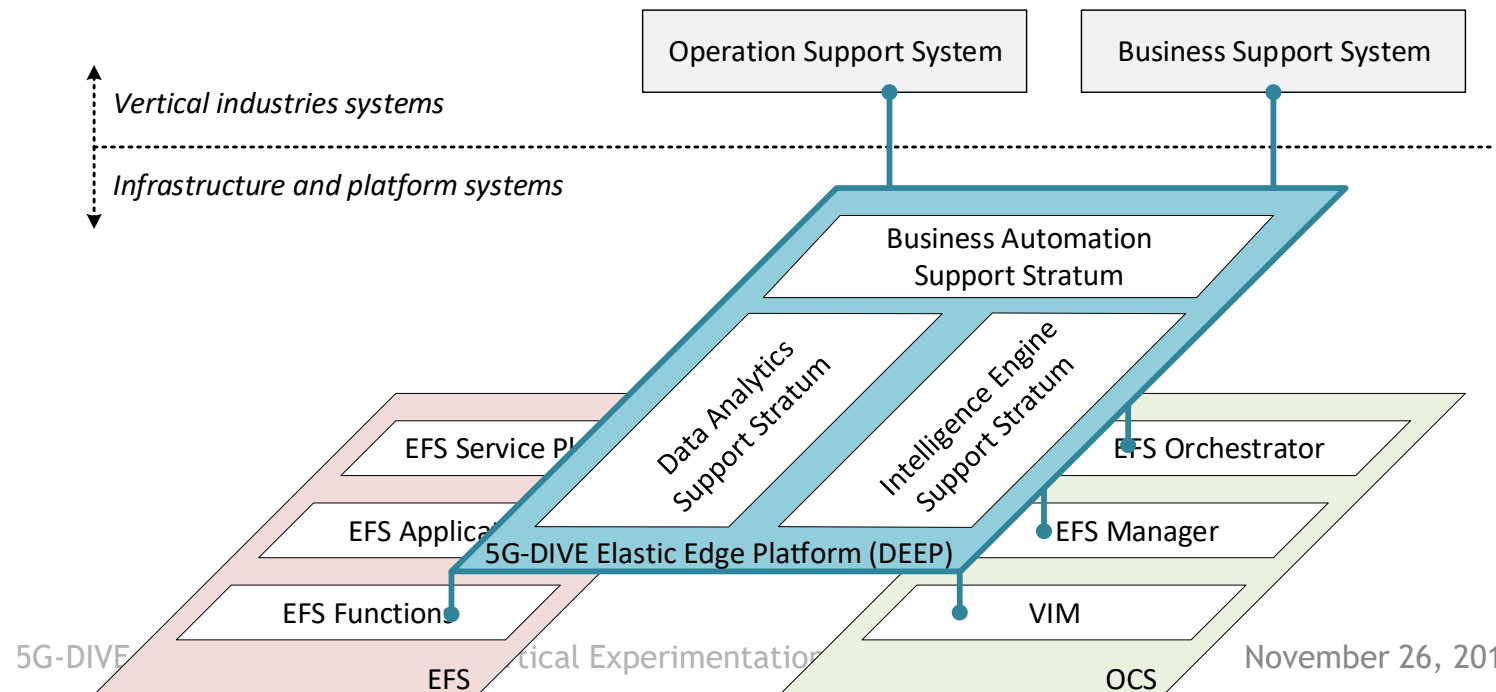
comprising the virtualization infrastructure where all proposed virtualized functions, services, and applications are hosted.

(2) OCS:

managing, controlling and orchestrating the EFS, and its interworking with other domains.

(3) DEEP:

supporting vertical industries in day-by-day operations, management, and automation of businesses processes on-top of an edge and fog infrastructure.



DEEP – 5G-DIVE Elastic Edge Platform

- Leverage automation and intelligence capabilities by:
 - Providing support for a data analytics platform suitable for distributed and heterogeneous edge and fog environment
 - Providing support for an intelligence engine platform encompassing heterogeneous resources including terminal devices
 - Providing support to the vertical industries to achieve the automation of their business processes by allowing to plug their OSS/BSS systems in the platform.

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Vertical Pilots

Vertical Pilots – Industry 4.0

Digital Twin Apps

- Provides a virtual replica of a robot or of a part of a production line.
- The 5G network coverage will be deployed to enable real-time visibility and remote insights into robot status and performance without having to directly operate on the physical machine.
- Facilitates assessing the concepts of remote control, monitoring for preventive maintenance, and safety.

Real Time Video Analysis for Zero Defect Manufacturing

- Explores the capabilities of Fog/MEC/Cloud multi-tier Edge to address this local processing and visualization of geometric features for manufactured parts.
- Deploys in the Fog devices (e.g., video cameras), algorithms able to detect characteristic patterns for defects in the production.
- ZDM techniques may potentially reduce scrap by 100%, and predict form and/or welding errors.

Vertical Pilots – Autonomous Drone Scout

Drone Fleet Navigation

- Improves current Drone product portfolio, enabling a better piloting of the Drone swarm.
 - Providing intelligence in the Drones
- Enables new Drone-based services:
 - delivery, inspection and monitoring, scouting, Aerial Imaging, and precision agriculture on large scale.

Intelligent processing of images in the Drones

- Enables the deployment of intelligent functions in the Drones and its cooperation with the different tiers of the 5G-DIVE platform.
- More automation in the scouting processes, creating a new value chain of services which can be used to provide more services to the customers.

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Final Remarks

Final Remarks

5G-DIVE Project expects to have major impacts on:

1. validating 5G technologies, focusing on 5G connectivity including 5G New Radio, Crosshaul transport and Core
2. validating the virtualized edge and fog computing including control, management and orchestration of 5G resources
3. designing and validating the 5G-DIVE solution in real-life testbeds using assets (hardware, software and spectrum) in Europe and Taiwan
4. Mimicking the deployment of the targeted vertical use cases

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