5G-enhanced verticals

Contributions of the 5GROWTH project into the railways and energy sectors

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Outline

- The H2020 5GROWTH Project
- The Vertical Pilots in Aveiro (Portugal)
  - Transportation sector
  - Energy sector
- Expectations

5Growth

- ***Objectives***
  - The main objective is the technical and business validation of 5G technologies from the verticals' points of view, by performing field-trials on 4 vertical sites
  - Leverage on the results of 5G-PPP Phase 2 projects, mainly 5G-TRANSFORMER
  - Apply and enhance two ICT-17-2018 5G End-to-End platforms: 5G EVE and 5G-VINNI

- ***Pilots and field trials***
  - 4 pilots across 4 vertical industries
  - 9 use cases will be field-trialed on 4 vertical-owned sites (in Spain, Italy, Portugal) in close collaboration with the vendors (Ericsson, Interdigital, NEC, Nokia) and the operators (Telefonica, Telecom Italia and Altice Labs/PT)

- ***Consortium (21 partners)***
  - Verticals: Innovalia, EFACEC Engineering/Systems, Comau
  - Operators: Telecom Italia, Telefonica, Altice Labs
  - Vendors: NEC, ERICSSON Spain/Italy, NOKIA Bell Labs, IDCC
  - SMEs: Nextworks, Mirantis, Telcaria
  - Research Centers: CTTC
  - Universities: POLITO, SSSA, UC3M, NKUA, ITAv

5growth.eu

twitter.com/5growth_eu

linkedin.com/in/5growth-project

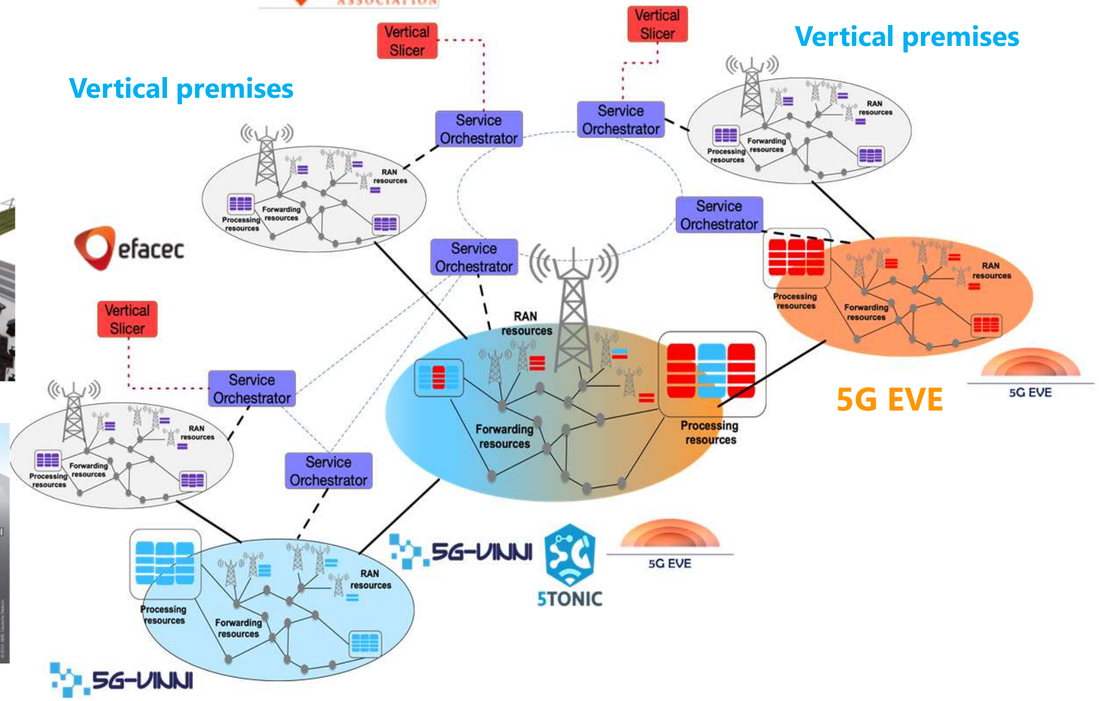
Vertical pilots

- 5Growth aims to perform real field trials involving customer sites of four vertical locations in Portugal, Spain & Italy
- This requires the development, installation, validation and testing of pre-commercial 5G radio, transport and core technology in vertical sites, connected via the ICT-17 platforms

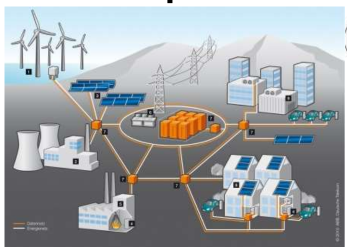
- Pilots
  - **Industry 4.0:**
    - INNOVALIA
    - COMAU
  - **Energy:**
    - EFACEC_E
  - **Transportation:**
    - EFACEC_S

Industry 4.0

Industry 4.0



Transportation



Energy

Vertical use cases

Field-trial-based approach on vertical sites (TRL 6-7). In total, 4 pilots across 4 verticals and 9 use cases:

Industry 4.0 (INNOVALIA1): Connected Worker Remote Operation of Quality Equipment

Industry 4.0 (INNOVALIA2): Connected Worker Augmented Zero Defect Manufacturing (ZDM) Decision Support System (DSS)

Industry 4.0 (COMAU1): Digital Twin Apps

Industry 4.0 (COMAU2): Telemetry/Monitoring Apps

Industry 4.0 (COMAU3): Digital tutorials and remote support

Transportation (EFACEC_S1): Safety Critical Communications

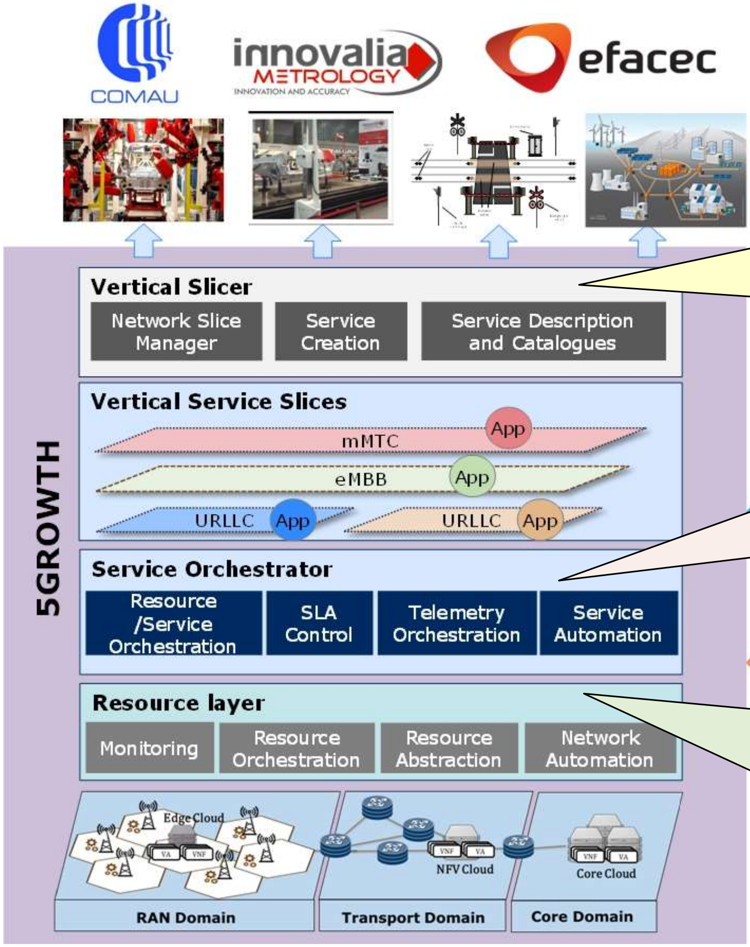
Transportation (EFACEC_S2): Non-safety Critical Communications

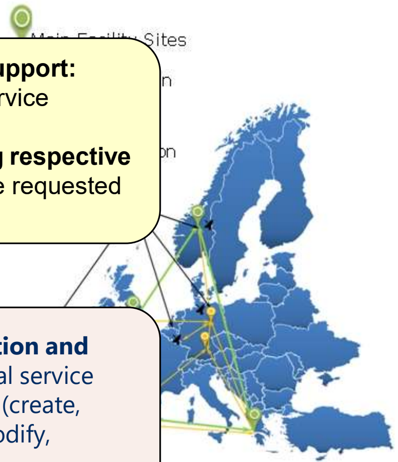
Energy (EFACEC_E1): Advanced monitoring and maintenance support of secondary substation - Medium Voltage/Low Voltage (MV/LV) distribution substation

Energy (EFACEC_E2): Advanced critical signal and data exchange across wide smart metering and measurement infrastructures

5Growth vision on innovations

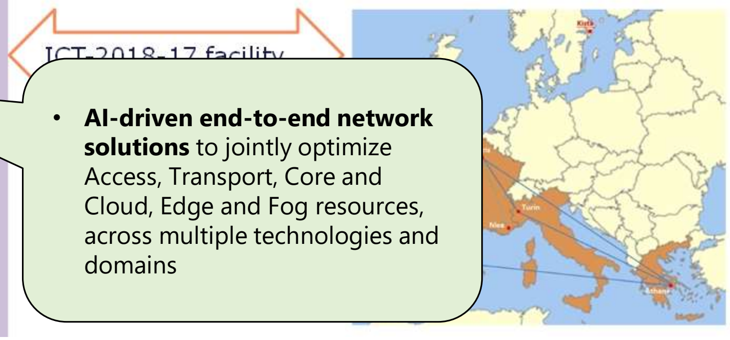
To empower vertical industries, such as Industry 4.0, Transportation, and Energy with an **AI-driven Automated and Shareable 5G End-to-End Solution**





- **Enhanced vertical support:** processing vertical service requests
- **Building & Managing respective network slices** for the requested services

- **Closed-loop automation and SLA control** for vertical service lifecycle management (create, instantiate, update/modify, terminate...)



- **AI-driven end-to-end network solutions** to jointly optimize Access, Transport, Core and Cloud, Edge and Fog resources, across multiple technologies and domains

5GROWTH

Ongoing - Two main verticals addressed in Aveiro (Portugal)

- Transportation
  - Use Case 1: Critical and safe communications for Railway signaling
  - Use Case 2: Non-critical and safe communications for Railway signaling
- Energy
  - Use Case 1: Monitoring and Maintenance of Power Substations
  - Use Case 2: Critical signaling and data exchange across smart metering infrastructure

Transportation

Use Case 1: Critical and safe communications for Railway signaling

Transportation

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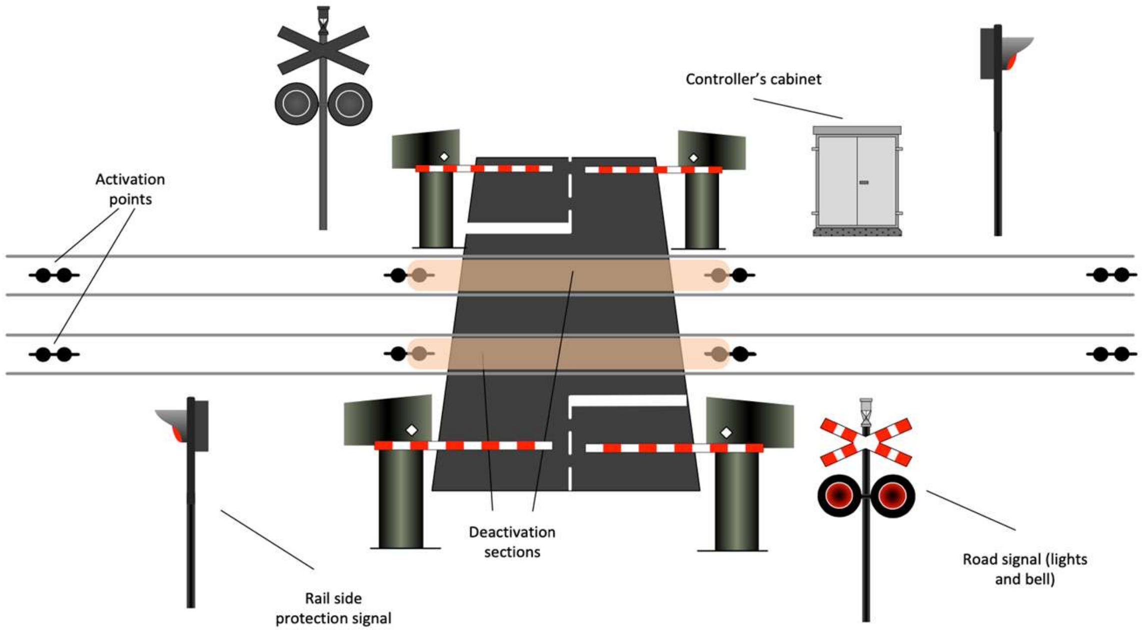
5GROWTH

Transportation

Use Case 1: Critical and safe communications for Railway signaling



Transportation

Traditional support for Level Crossings:

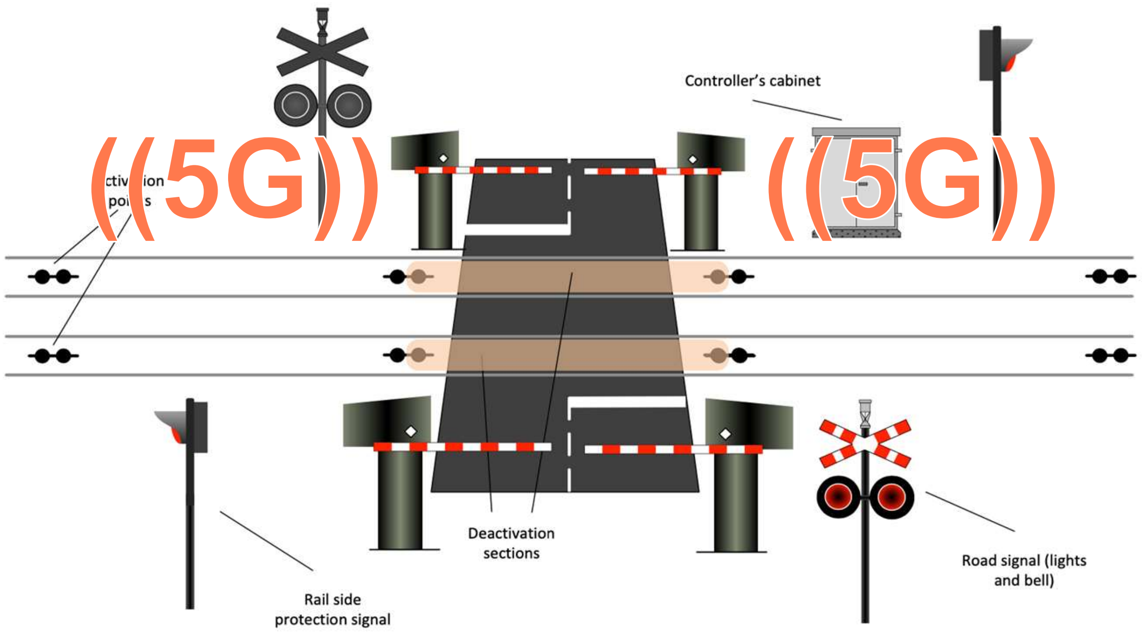
- Communication must comply with railway signalling safety communication standards
  - Objective: Reliability, Availability, Maintenance and Safety (RAMS)
- How
  - Usage of copper wires (i.e., private network)
  - Usage of proprietary protocols (CENELEC)
  - Video is not available
- Opportunity for 5G
  - Added flexibility
  - Performance increase allows for new opportunities and scenarios

Transportation

- Replace cabled-based networks by 5G technologies
- Reduce system CAPEX by 20%
- Reduce installation cost by 50%
- Reduce installation time by 50%
- Reduce cable cost by 80%
- Reduce maintenance visits by 20%
- Reduce service response time by 20%

Transportation

Use Case 1: Critical and safe communications for Railway signaling

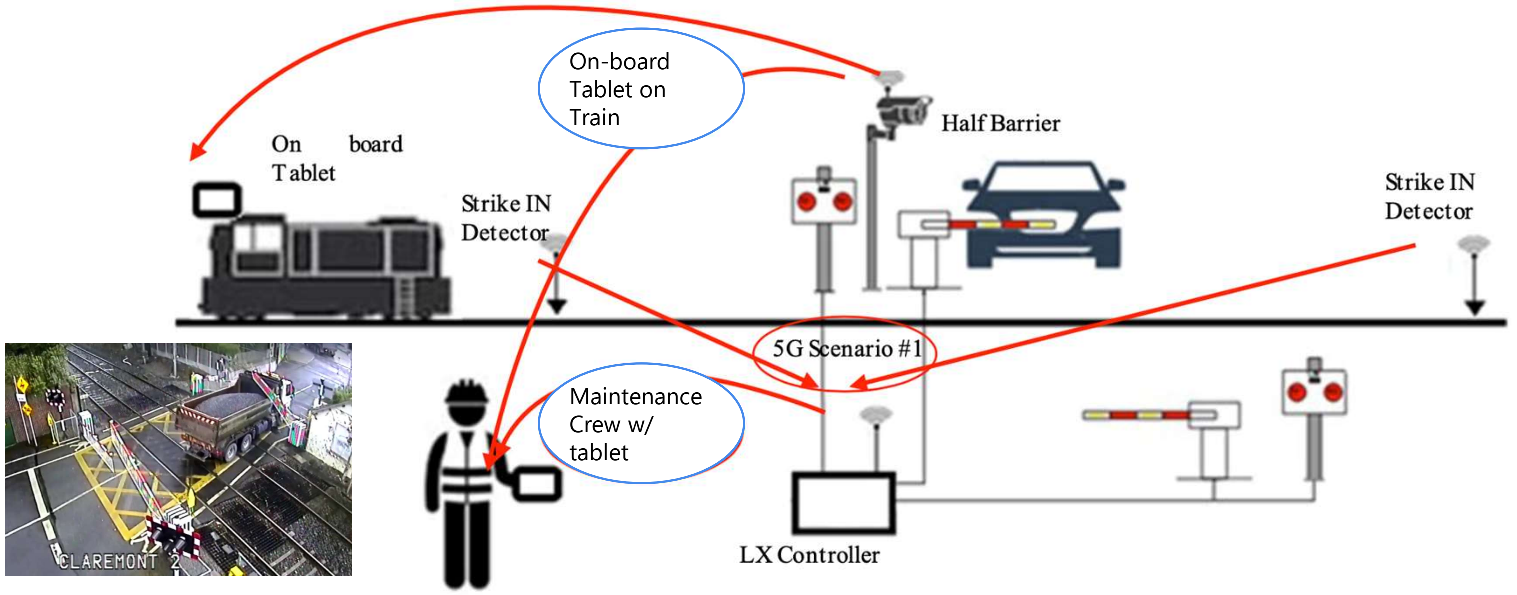


Transportation

Use Case 2: Non-critical and safe communications for Railway signaling

Transportation

Use Case 2: Non-critical and safe communications for Railway signaling



Energy

Use Case 1: Monitoring and Maintenance of Power Substations

Energy

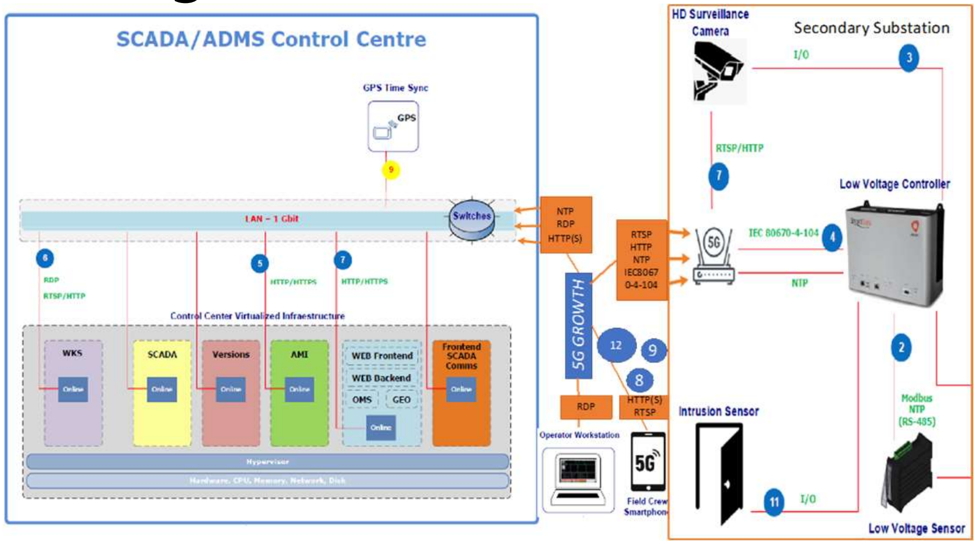
- Traditional support for Inteligent Eletronic Devices communication:
  - Usage of SCADA (Supervisory Control and Data Acquisition)
  - GPRS and 3G/4G are used
    - Substation alarms and telemetry
      - IEC 60870-5-104 (DNP 3.0 in the USA)
    - Mobile Terminals (Maintenance crew)
      - REST/HTTP or SOAP/HTTPS
  - LoRA and Power Line Communications (PLC) are also used
    - Last Gasp
      - RF-Mesh research exists but is not scalable
  - Video is possible, but only in priority devices (primary substations)

Energy

- Objectives
  - Improve critical signal's communication from smart sensors existing in electrical infrastructure
  - Allow more advanced control applications (e.g., cloud-based)
  - Improve outage management
    - Monitoring & maintenance of secondary substations
    - Improve low-voltage distribution networks monitoring
  - Reduce Average Interruption Duration Index (SAIDI) in 15%
  - Reduce Energy Not Supplied (ENS) in 5%

Energy

Use Case 1: Monitoring and Maintenance of Power Substations



Energy

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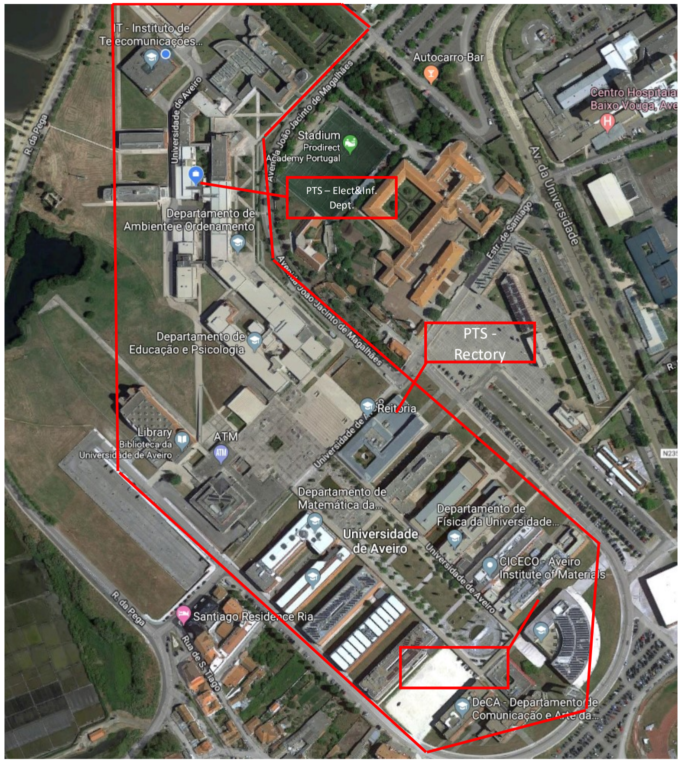
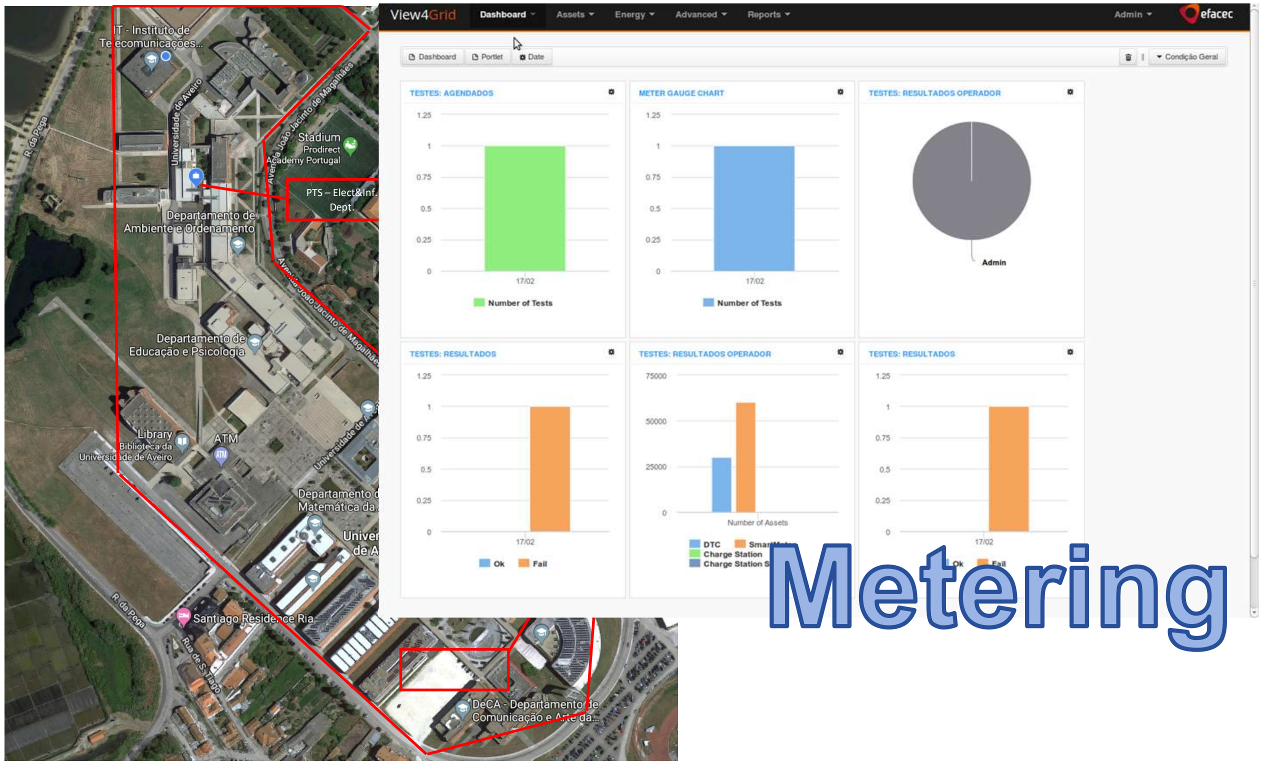


Energy

Use Case 1: Monitoring and Maintenance of Power Substations



Energy

Use Case 1: Monitoring and Maintenance of Power Substations

HD Surveillance

Energy

Use Case 1: Monitoring and Maintenance of Power Substations

Energy

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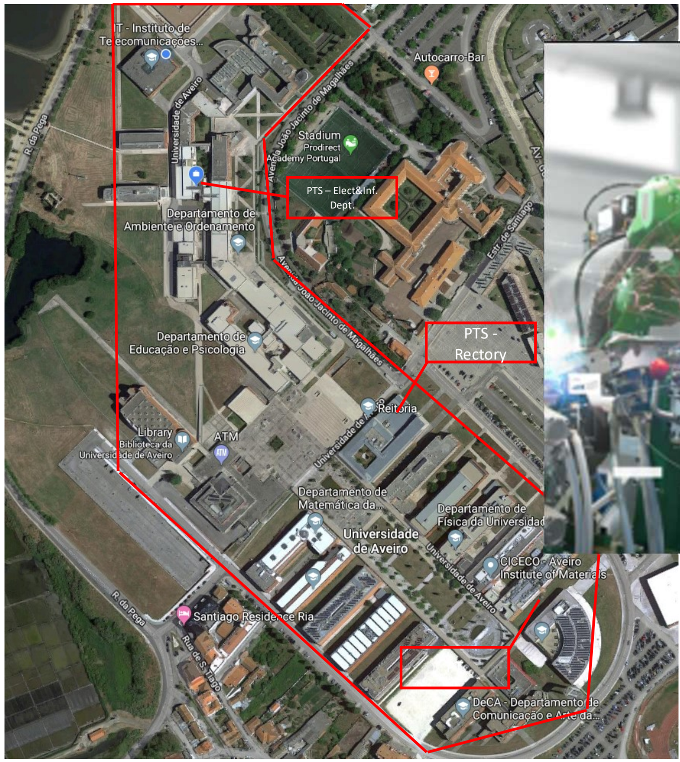
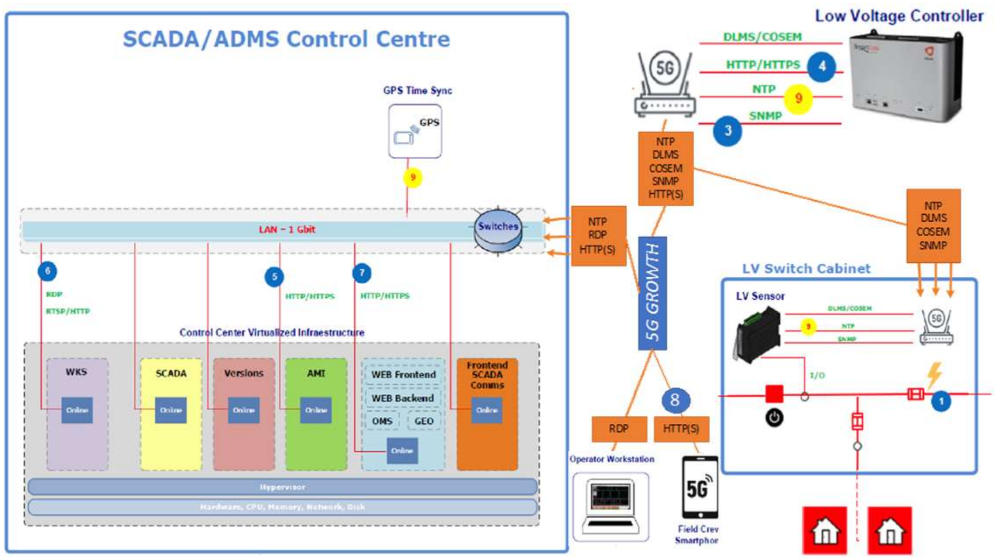
Use Case 1: Monitoring and Maintenance of Power Substations



Augmented Reality

Energy

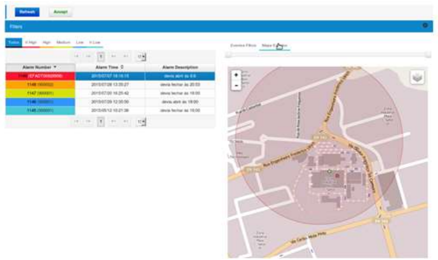
Use Case 2: Critical signaling and data exchange across smart metering infrastructure



Energy

Use Case 2: Critical signaling and data exchange across smart metering infrastructure

- Last Gasp information reads transmission
- Device (meters and sensors) synchronization
- Dispatch of information to teams and control sensors
  - Minimize duration of issue



Pilots: real locations

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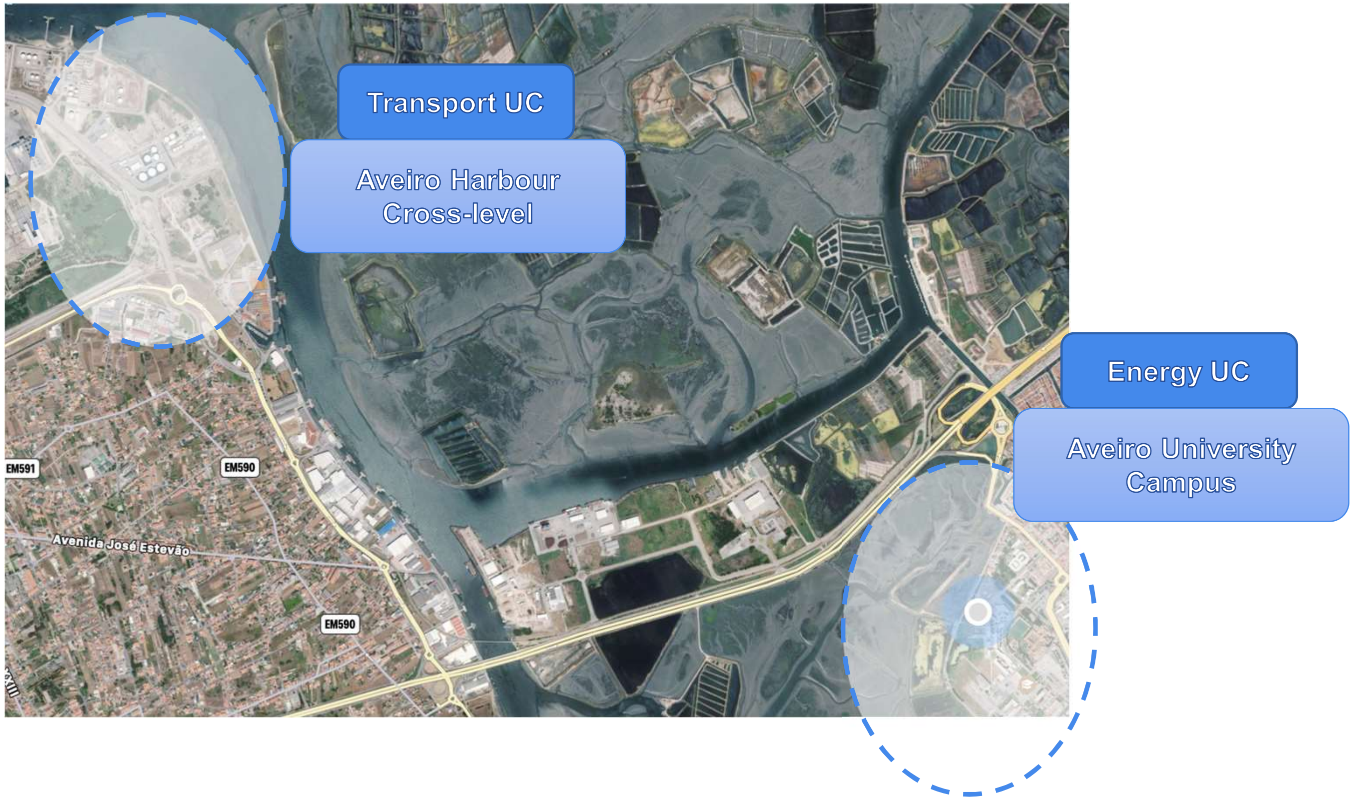

Pilots: real locations

Expectations from the Verticals

(What can 5G offer?)

Transportation Pilot

- Ultra-reliable Low-Latency Communications - URLLC
  - Transmit safety critical communications between the Level Crossing controller and the level crossing train detector
- Enhanced Mobile Broadband – eMBB
  - Transmit HD vídeo to the train controllers
- Ultra-reliable Low-Latency Communications – URLLC
  - Transmit alarms and controller status to the maintenance agents

Energy Pilot

- Enhanced Mobile Broadband - eMBB
  - Support vídeo camera and AR streaming
- Ultra-reliable Low-Latency Communications - URLLC
  - Time sensitive AR
- Massive Machine-type Communicaitons – mMTC
  - Transmission of critical signals

Other contributions from 5G

- Beyond Radio
- Virtualization
- Orchestration
- Multi-access Edge Computing
- …

Expectations from the Verticals

(Social, economic and others)

Transportation Scenario

- Social benefits - Significant reduction in number of accidents
  - 120k Level crossings exist in the EU*
    - 50 LC's per 100line-Km
    - 50% are active (e.g., have some automation)
    - Accidents
      - 300 people die annually in LC accidents in EU
      - Total costs: €1 billion / year (€850M in casualities alone)
      - 38,9% occur on unprotected LC's
      - Active LC's: 4,1%-30,6% (depending on the degree of automation)
  - Estimation: 5% safety benefits in terms of human lives
    - €50000M per year

*"Level crossings - European Union common safety indicators (ref. Directive 2014/88/EU)"

Transportation Scenario

- Economic benefits
  - Wireless links flexibility in comparison with wired links
    - Cost reduction:
      - Installation cost
        - No digging
        - Typically about 30% of the total (e.g., 140k for 1200 meters cable duct)
        - CapEx savings of 40k€ per level crossing
      - Installation Time
        - Current average time is 2-4 weeks
        - Switching from cable represents na average CapEx saving of 10k€ per LC
      - Maintenance and security
        - Cable failures and robberies
        - Usually around 1k/year per LC
        - Reduction of 20% in costs, around 200€ per LC, per year for OpEx

Transportation Scenario

- Economic benefits
  - 5G automated management and optimization
    - Vertical orchestration and slicing
      - Reduced human intervention → lower OpEx
      - Infrastructure usage optimization → lower CapEx
      - 3 sector macro site
        - OpEx: €1300/y (MEO, a Portuguese operator)
        - CapEX: €20k/y (also MEO)
      - Automated Sliced Network → lower CapEx (9%, compared to Physical CSP)
        - TCO reductions in the order of 23% ("Future X Network cost economics")
    - Savings
      - OpEx: €300 per site
      - CapEx: €1800 per site

Transportation Scenario

- Economic benefits
  - Replicability of the solution
    - European Market: 60k new generation level crossings
    - Average cost of transformation into next generation LC: 150k€
      - €9000M total investment for the 60k LC's
    - Yearly benefit >2.2bilion euro

Energy Pilot

- Power savings
  - Energy Not Supplied (ENS)
    - 5% reduction
    - Measured through Value of Lost Load (VOLL)
      - EU avg. 11€-26€/kWh
  - System Avg. Interruption Duration Index (SAIDI) - LV
    - EU avg. 120 min/consumer*year
    - 15% decrease
      - Savings of 98M€ to 232M€ (consumer side)
- Maintenance costs reduction
  - Local and remote
  - Edge computers and network operational costs
  - European scale
    - Benefits (est.) between 100M€ and 245M€

Energy Pilot

- Local Maintenance costs reduction
  - Avg. 7500 maintenance incidents (Low Voltage)
  - Avg. 100-120min per incident (50% due to fault localization time)
  - Assume:
    - 30€ unit cost (personnel cost per hour)
    - 70k secondary substations low voltage grid (Portugal)
    - 3M secondary substations in Europe (Extrapolation)
  - Savings: 268k hours → 8M€ / y

Energy Pilot

- Remote Maintenance costs reduction
  - Savings in highly skilled manpower
  - Using 5G for LV grid automation
    - 6500 secondary substations
    - Savings of 11k€ / y (EFACEC internal report)
    - Considering the previous 3M secondary substations
      - Remote maintenance cost savings = 5M€

(The 5G automated management and optimziation benefits also apply here!)

Conclusion

- Preliminary evaluation of the economic benefits for 5G-enabled verticals has been presented
- The objective was to understand if solutions are advantageous
- 5G allows a faster, safer and reliable connectivity
- But also allows for added flexibility, which through mechanisms such as virtualization, orchestration and others, contribute to CapEx and OpEx savings considerably

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Thank you!

Questions?

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