

Paris Session 2022



5G and the Power System Applications Requirements

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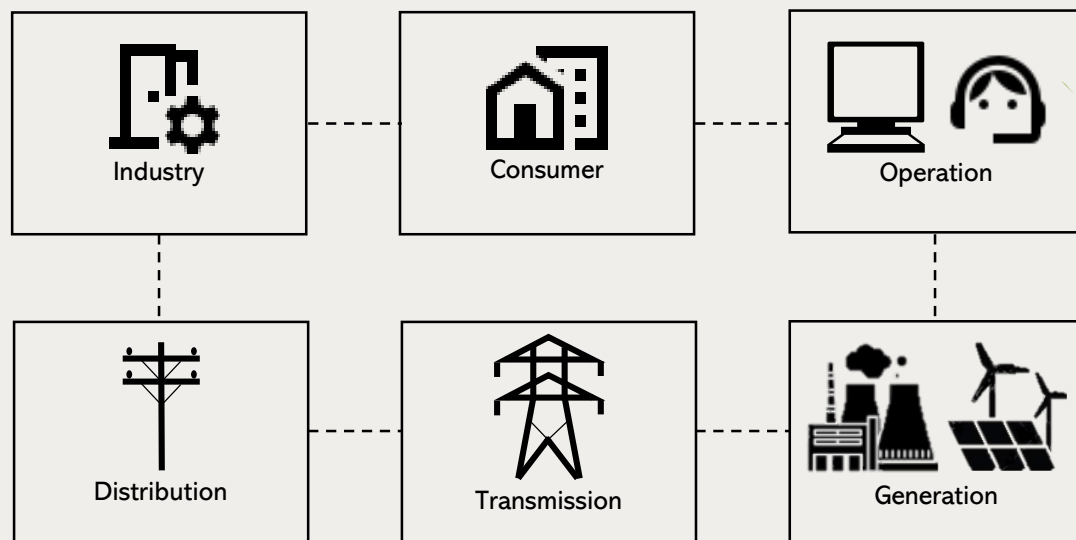
Table of contents

1. The digitalization of the electric system and its challenges
2. The 5G Technology
3. Power system applications requirements
4. 5G in the power system nowadays
5. Proof of Concept
6. Conclusion



The digitalization of the electrical system and its challenges

Smart grid is the transformation of the electrical system using new technologies and innovative tools from the power generation sector to the final consumer.



Smart City

Internet of Things

IEC-61850

Challenges:



1

Intelligent Devices

Massive integration of devices without compromising technical network requirements.



2

Latency

Strict requirements about time delay for critical mission applications.



3

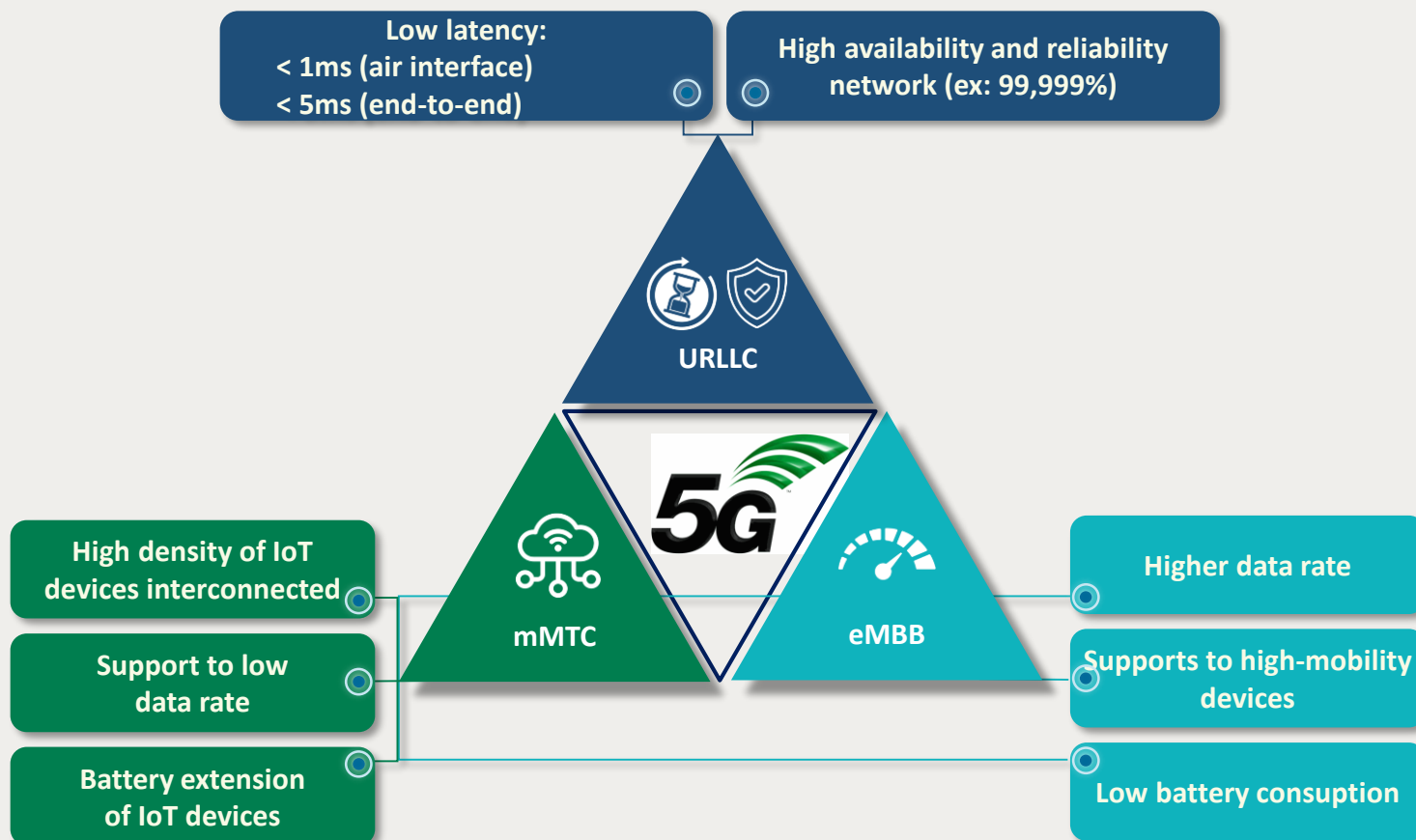
High investments

Adaptation of wired network infrastructure for applications, such as teleprotection.

Efficiency, security and innovation in communication infrastructures!

The 5G technology

Characteristics



Concepts and Enablers:

Network Slicing 

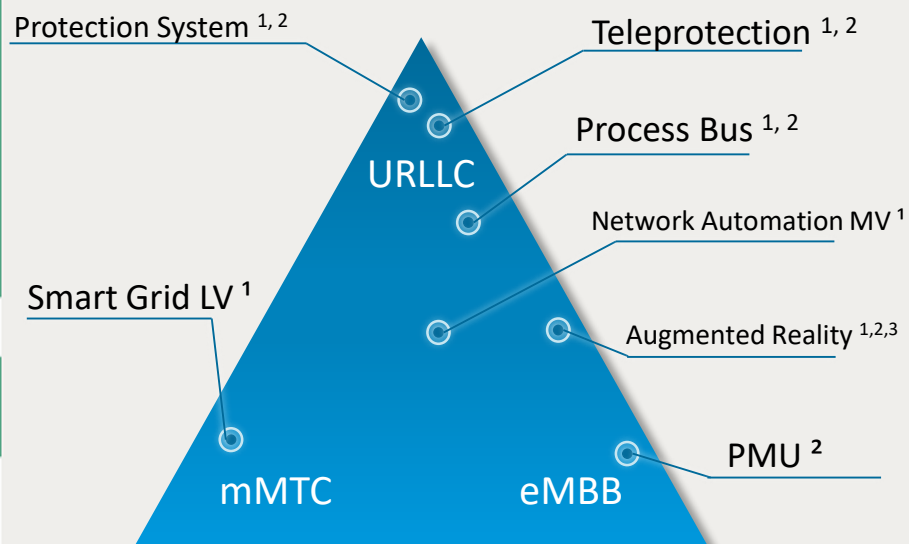
Edge Computing 

Private Network 

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Power systems applications requirements

¹ Distribution
² Transmission
³ Another applications



| | Data rate  | Latency E2E  | Reliability  | Availability  | Density of connection  |
|--|--|--|--|---|--|
|--|--|--|--|---|--|

| | | | | | |
|---|-----------|---------------------|----------|----------|--------|
| Teleprotection | < 64 kbps | < 10 ms | 99,999 % | 99,999 % | Low |
| Process Bus: Analog signals | > 15 Mbps | 3 - 10 ms | 99,999 % | 99,999 % | Low |
| Protection System | < 10 kbps | 3 - 10 ms | 99,999 % | 99,999 % | Low |
| Phasor Measurement Units (PMU – Cass M) | > 62 kbps | 500 ms | 99,000 % | 99,98 % | High |
| Smart Grid in Distribution Field (Low Voltage) | 1 kbps | < 1 s | - | 99,897 % | High |
| Medium Voltage Network Automation | > 1 Mbps | < 50 ms | 99,999 % | 99,990 % | Medium |
| Augmented Reality (for intelligent inspections) | > 1 Gbps | <10 ms* <1 ms ** | 99,999 % | 99,999 % | Low |

* General Applications
 ** Critical Applications

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5g in the power systems nowadays

Cases around the world

- 1 Process Bus communication using 5G Wireless System;
- 2 Topology Identification Method of Urban Power Grid based of 5G Communication;
- 3 Distributed Fault Recovery Scheme of Active Distribution Network;
- 4 Application of 5G communication Technology on intelligent inspection in 750 kV substation;

2019 IEEE 30th Annual International Symposium on Personal, Indoor and Mobile Radio Communications (PIMRC): Track 4: Services, Applications, and Business

1 Enabling Process Bus Communication for Digital Substations Using 5G Wireless System

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2 Topology Identification Method of Urban Power Grid Based on 5G Communication

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Abstract: With the development of 5G communication technology of urban power grid, intelligent distributed control and protection will become the trend of intelligent distribution network. The characteristics of flexible configuration and strong scalability of 5G communication technology provide a wireless solution, which greatly improves the reliability of distributed control technology. Based on 5G communication technology, a distributed topology identification method is proposed. In this solution, the method only needs to configure its associated static network topology information to form dynamic network topology information according to certain conditions. The purpose of identifying topological information is to provide topological information support for advanced functions of the network, such as the reclosing, identification of distributed power islands, and power supply.

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4 Application of 5G communication technology on intelligent inspection in 750kV substation

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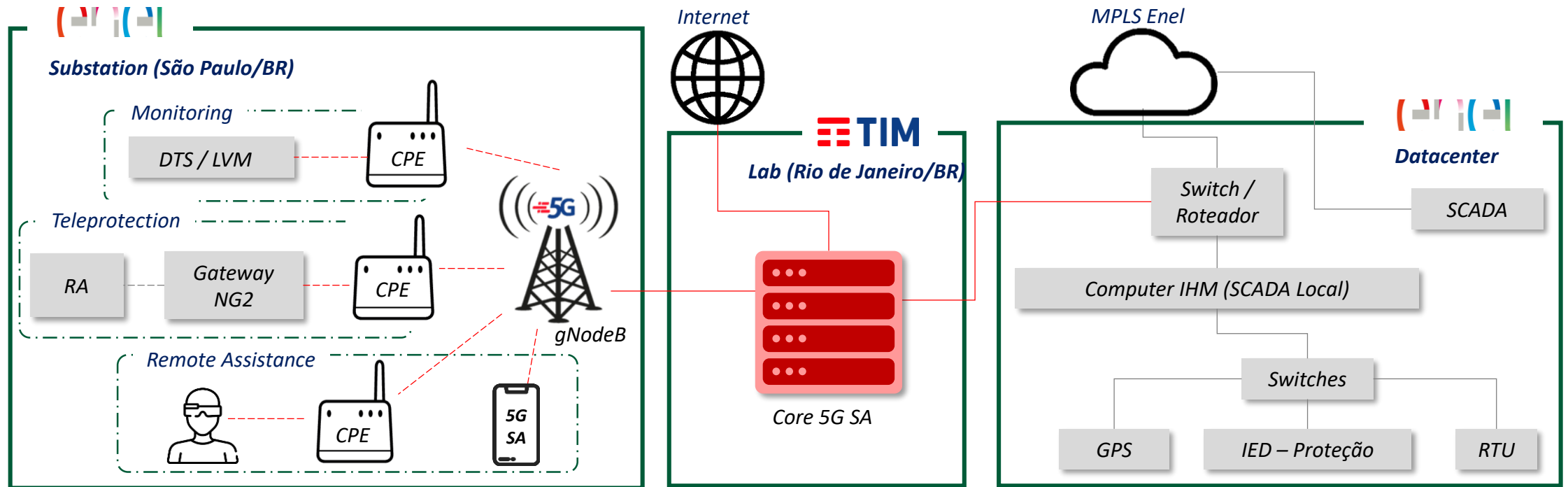
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Abstract: As more and more distributed power sources are connected to low and medium voltage distribution networks, the traditional single-ended passive distribution networks have evolved into multi-terminal, multi-source active distribution networks. When distributed generations with high permeability are connected to a distribution network, the structure and power flow of this network will change significantly, thus the original fault detection method and reclosing scheme may be challenged, which may cause incorrect action of protection or failure of reclosing. On basis of that, this paper proposes an active distribution network fault recovery scheme based on 5G wireless communication, in which the topology recognition technology and smart terminal units with peer-to-peer communication capability are applied. To prove the method's feasibility, delay of 5G communication is analysed and tested online. In addition, a model of 10 kV active distribution network is built on Real Time Digital Simulation system. Principle investigation and simulation indicate that the proposed scheme can adapt to the change of network structure and implement the fault self-healing quickly.

Proof of Concept

Remote assistance with HoloLens virtual reality glasses
using a “Digital Twin” architecture

Proof of Concept

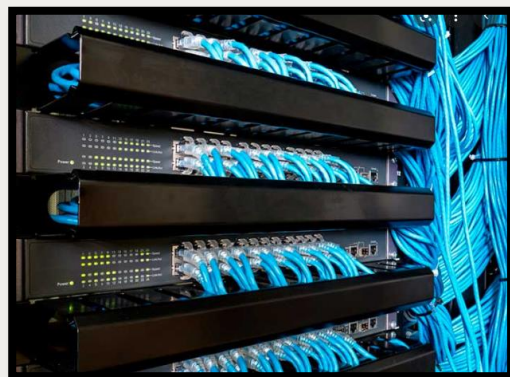


TIM
 ENEL

| Setup | Max. DL Rate | Max. UL Rate | Latency RTT |
|----------|--------------|--------------|-------------|
| CPE – 5G | 613 Mbps | 40 Mbps | 40 ms |
| 5G – 5G | 1231 Mbps | 82 Mbps | 43 ms |
| 4G – 4G | 50 Mbps | 10 Mbps | 40 ms |

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Conclusion



ACKNOWLEDGEMENTS:

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Thank you!

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