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Question 3.1: Discuss the rationale, advantages and potential challenges in adopting a private 5G network for a power utility.

The digitalization process and the development of new technologies have been protagonists in optimizing faster, more efficient, and automated solutions for the electrical system. A series of technologies have been developed as alternatives to traditional methods of operating the electrical network, such as the use of wireless networks, in order to facilitate and solve wired and conventional infrastructure problems in the sector's applications. However, the more efficient connectivity between devices, the strict protection action time delay required, and the need for more efficient and safe use of the electrical system's communication infrastructure, among others, are increasingly priority needs and not so simple to achieve in the scope of wireless networks. So far, several wireless technologies such as ZigBee, LoRaWAN, Wi-fi, and even 4G have been widely used in communication architecture in industrial and electrical energy distribution systems.

Recently, the characteristics proposed by the fifth generation of cellular networks, 5G, have presented facilitators for the criticalities required by the electric power sector. Due to its significant advantages over previous generations in terms of transmission rate, bandwidth, reliability, security, energy consumption, and higher simultaneous connections, 5G has been considered the technology that will allow the development of even more efficient solutions for the electric sector.

Currently, many expectations have been created regarding 5G in various sectors. In the industrial sector, the so-called industry 4.0 is already a reality. Architectures have been proposed using edge computing and the low latency of 5G in private networks, which enables constant and uninterrupted monitoring of the industrial plant and contributes to its preventive maintenance. Through the 5th Generation Public-Private-Partnership (5GPPP), the European Commission has established several supports as part of the Connecting Europe Facility Digital (CFE Digital) program to accelerate the development of solutions through 5G technology, such as autonomous vehicles, urban mobility, smart cities, among others.

In the electricity sector, to minimize the wired communication infrastructure in distribution networks, some works have developed methods to identify the topology of a network using 5G technology for communication between intelligent devices. In this context, through the Slicenet project proposed by 5GPPP in Europe, Efacec conceived a self-healing solution through 5G technology to reduce the area affected by the fault in the distribution network, reconfiguring the network more quickly.

Furthermore, aspects such as high sensing capacity and the application of augmented reality are being developed to use 5G communication for intelligent inspection in power substations. This AR application has been tested by some power distribution companies in Brazil, to increase reliability and reduce the cost of maintenance and inspection of the facilities.

Due to these disruptive characteristics of 5G, large applications can be developed mainly in the energy distribution sector. Many studies still need to be done for the transmission sector, given the criticality of applications in this sector. In Brazil, ONS (Power System National Operator), which is the entity responsible to establish the technical requirements for the power system, does not allow the use of cellular networks for critical mission applications such as teleprotection in the transmission sector, for example. Still, as technology evolves and consolidates, nothing prevents this application from being evaluated in the distribution sector.