

Dynamic Data Exchange Method between DSO and Wind Farms for Smart Grid Applications

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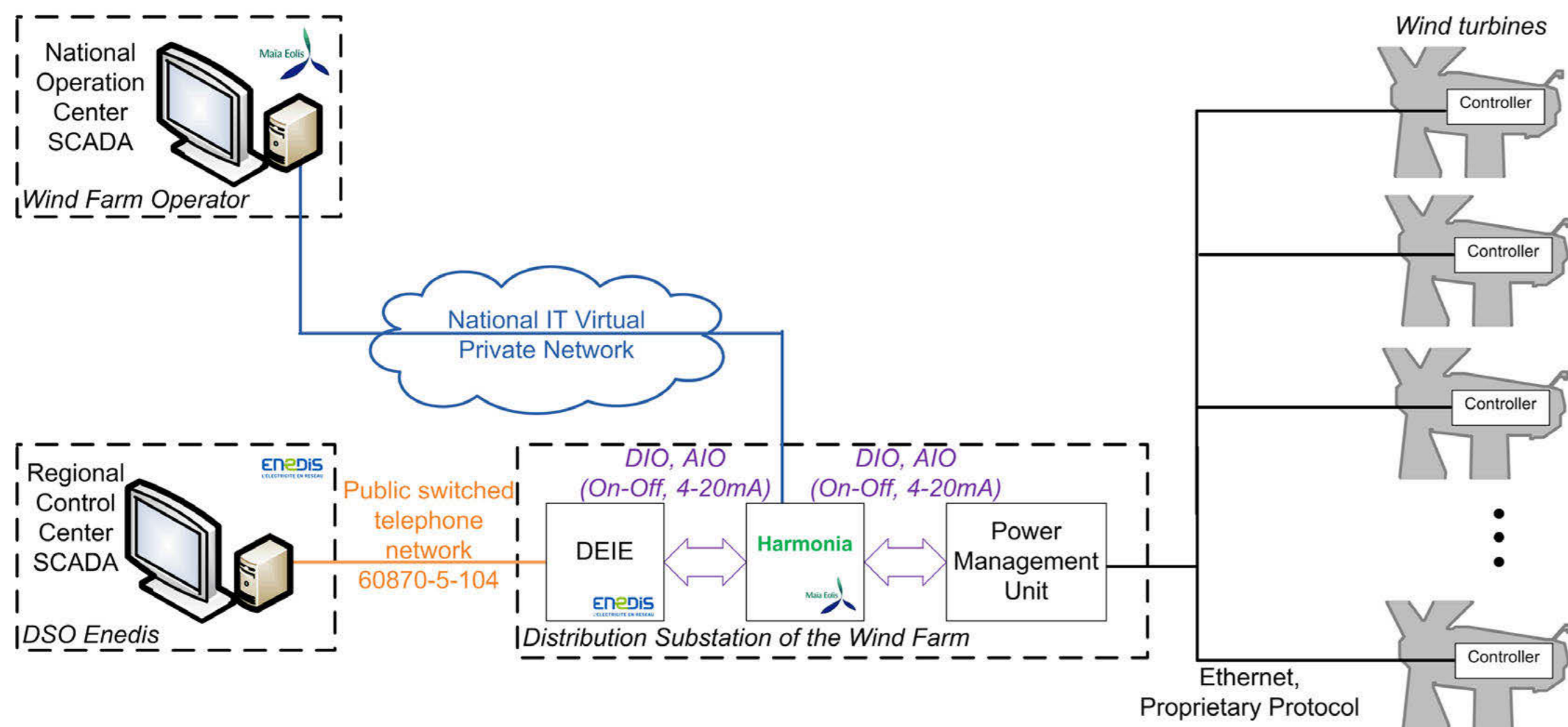
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Abstract

The integration of wind farms to smart grids like conventional power plants is one of the major challenges to improve the grid flexibility. The implementation of ancillary services needs not only local electrical capabilities but also remote dynamic data exchanges between DSO and wind farms. The traditional data exchange system in France from DSO regional control centers to wind farms has been standardized in 2005 and industrially deployed from 2010.

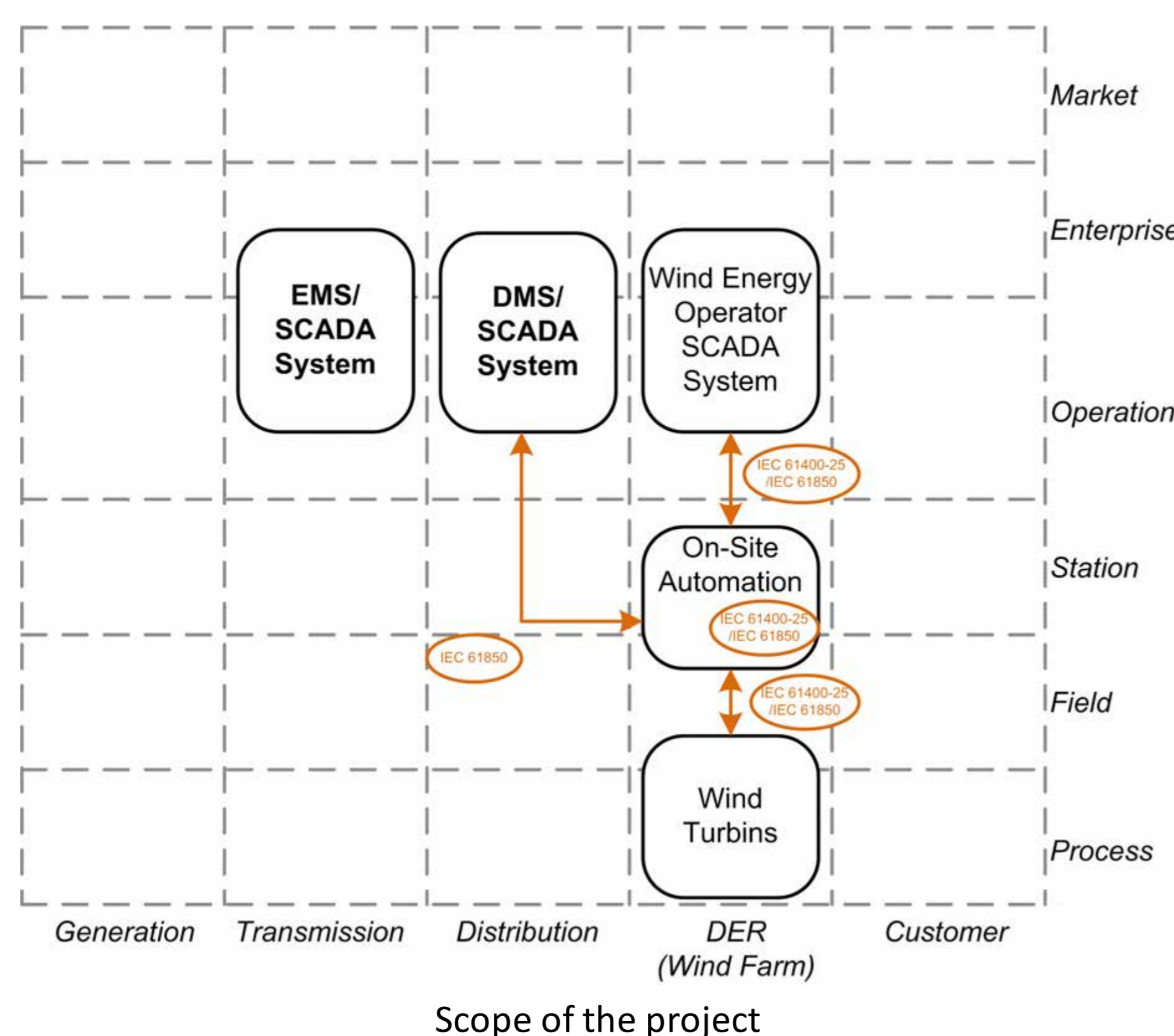
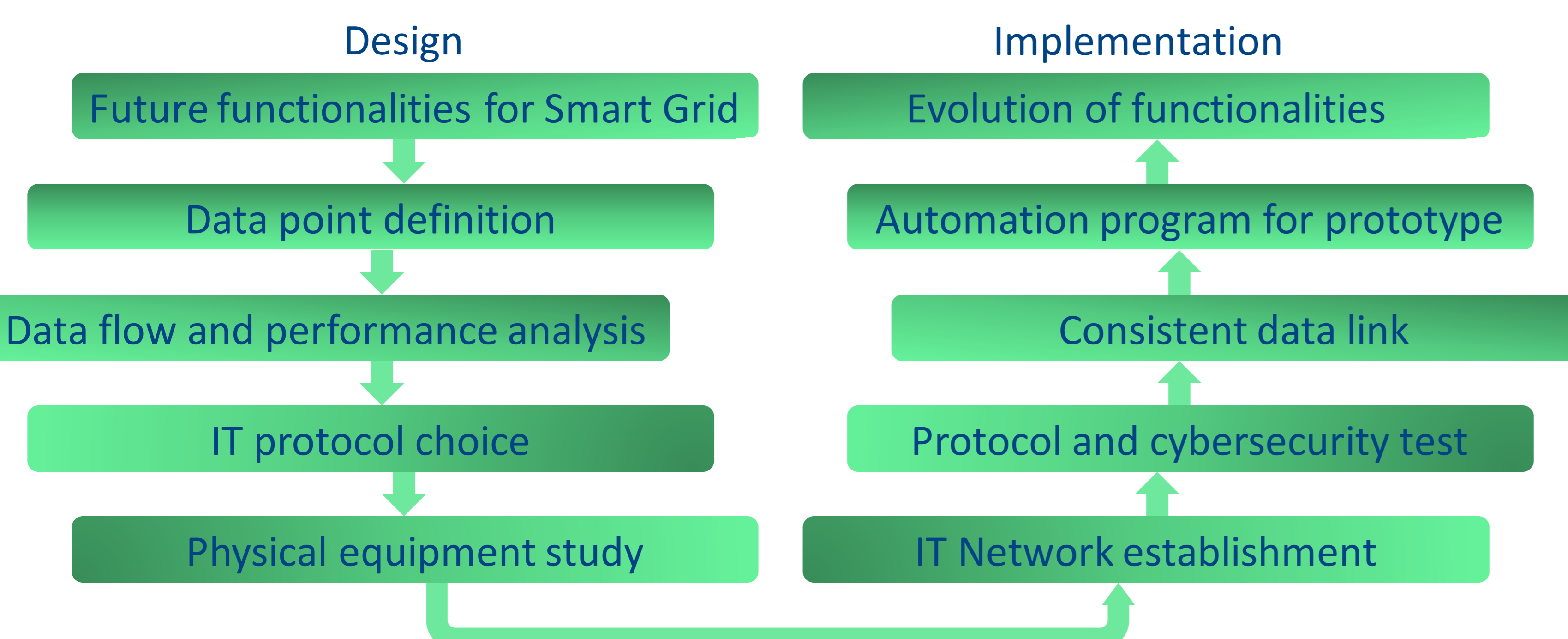


In the most cases as designed, this communication is established by modem calls only when it's needed several times a year according to the DSO or TSO maintenance schedule, far behind the future dynamic requirements. Hence EDF R&D, ERDF and Maia Eolis work tightly together since 2014 for the application of real-time data exchanges based on Ethernet communication method, especially applied by IEC 61850, IEC 61400-25 and IEC 60870-5-104 protocols.

Objectives

The main idea of this work is to reconstruct the data link from DSO to wind farms by a continuous Ethernet real-time communication for data acquisitions and control possibilities. Based on a good understanding of DSO requirements and wind farm capacities, tremendous works of several aspects, focused on communication protocols, physical layer transmission media, application functionalities and cybersecurity, have been studied thanks to a versatile knowledge of information technology, electrical engineering and automation.

Methods



Results

In 2015, the isofunctional version of two prototypes have been successfully implemented.

The IEC 60870-5-104 protocol is implemented for an integration to the current DSO SCADA system. In parallel, the XMPP (Extensible Messaging and Presence Protocol) web service mapping for IEC 61850 is achieved as an alternative solution for a comparison. In replacement of the current cable wirings, the local interface with wind farm equipments are modernized by MMS based IEC 61400-25 and IEC 61850 protocols for completing the whole data transmission chain.

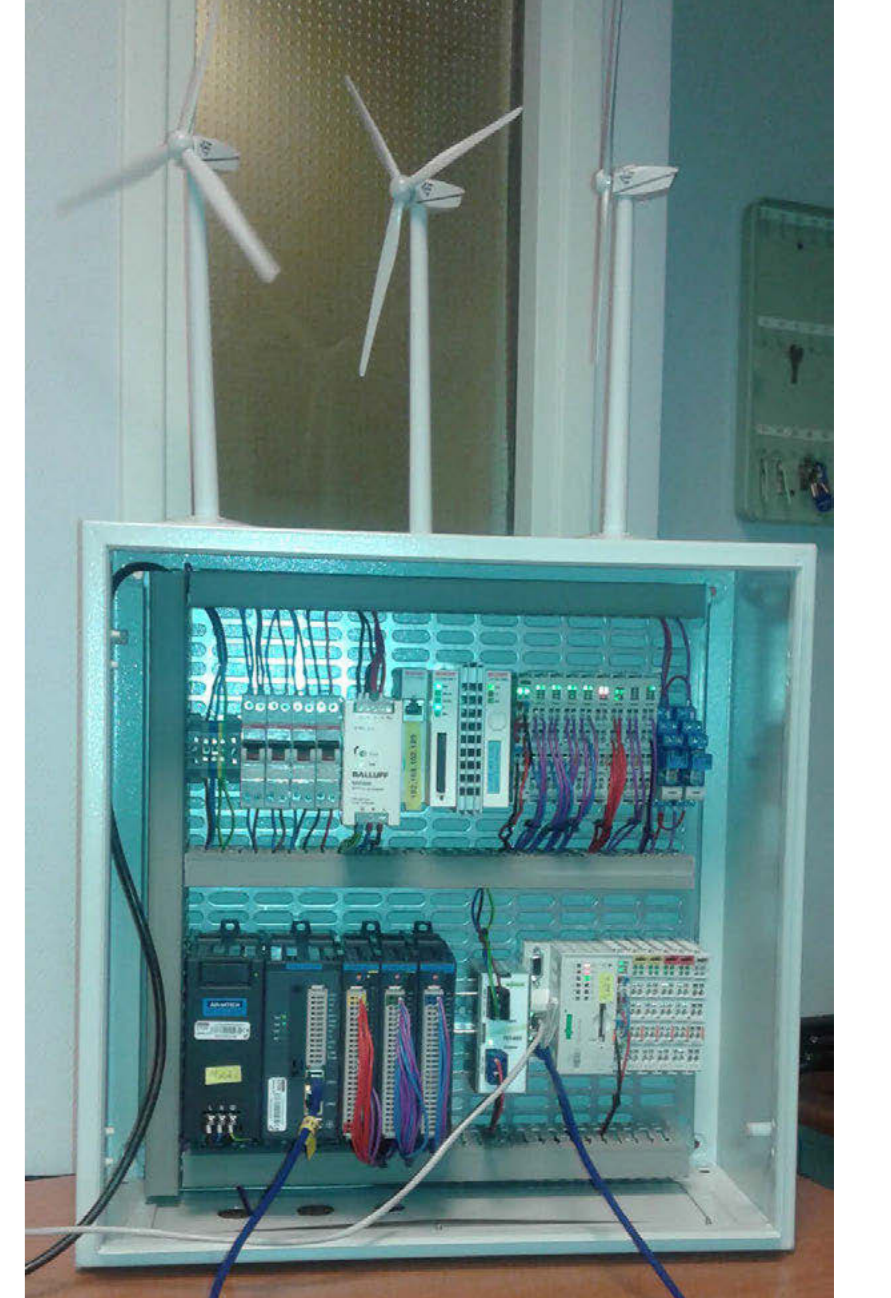
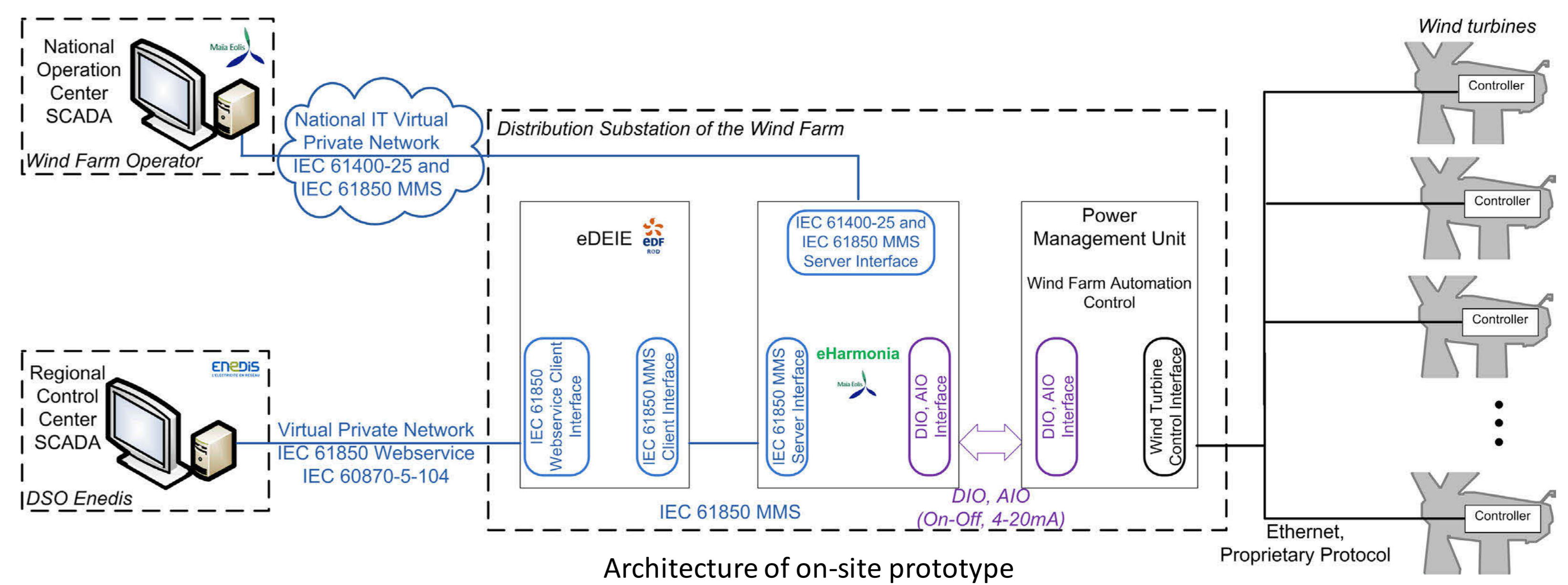


Photo of prototype in laboratory

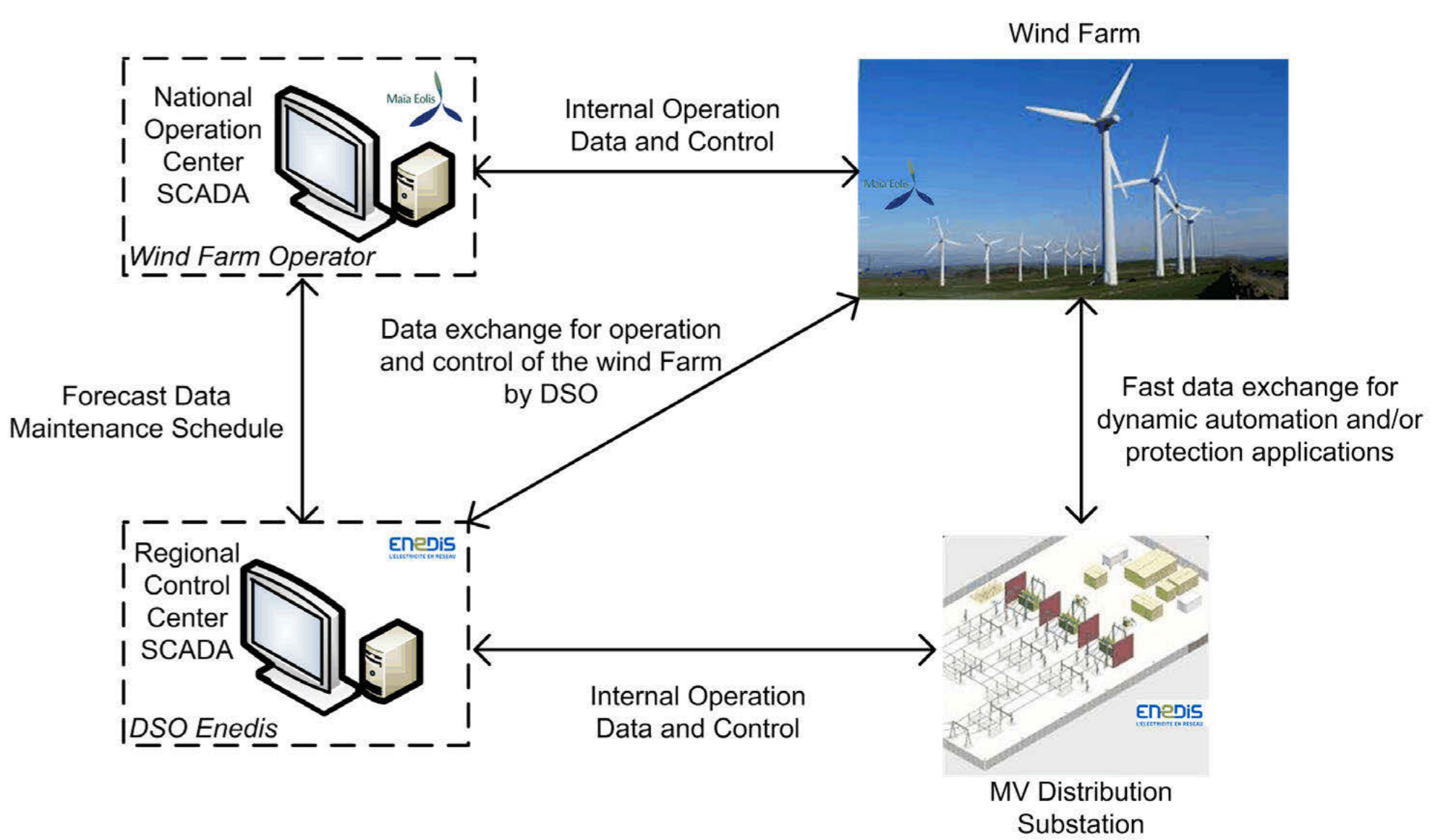
Several cybersecurity functions have been implemented according to IEC 62351, such as encryption with SSL/TLS, end-to-end security and certificate-based authentication.



Architecture of on-site prototype

Perspectives

Wider tests for additional functionalities are in schedule of 2016, for example the dynamic power curtailment for a wind farm by taking into account real-time power flows in the MV substation, in order to increase the availability of the substation despite of its saturation risk.



Possible architecture in the future

Conclusions

This study provides an industrial R&D application of a dynamic, flexible and secured data exchange method for the real-time communication between DSO and wind farms.

The result of this work could be one of good technical solutions to increase the wind energy penetration. It gives a fresh reference feedback for the application of IEC 61850, and helps to promote the ongoing IEC 61850-8-2 standard. The discussion on future functionalities and signals could inspire further improvement of the wind farms integration and even be a step toward the data exchange standardization between DSO and wind farms.

In addition, the advantage of an Ethernet Server-Client protocol rather than a point-to-point connection could make an easy expansion for future TSO data connections.

References

1. DSO Interacting With Heterogeneous DER in Distribution Grid, T. Coste, O. Carré, P. Li, *CIREN Workshop 2016*
2. Improving the integration of wind power plants into the electrical networks: a new definition of the available power capacity, L. Ruiz, N. Girard, S. Guignard, *European Wind Energy Association Annual Event (EWEA) 2015*
3. IEC 61850 7-420: Basic communication structure – distributed energy resource logical nodes
4. VENTEEA ERDF Smart Grid Demonstrator: (<http://www.venteea.fr/en/context/>)
5. PACWorld paper magazine: New IEC 61850 Protocol - Mapping based on XMPP _ September 2015.

