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**Project Title:** Study and technical review of specifications of telecommunication and control requirements of communication links of electric car charging station and electricity distribution network to electric car charging station.

<b>Department:</b>	Localization plan of infrastructure and components of electric vehicles	<b>Employer:</b>	Niroy Research Center
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<b>Type of Project/Program:</b>	Applied/developmental	<b>Assistant:</b>	Siavash Bayat

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**Keywords:** Electric car, electric car charging, charging standard, telecommunication and control network, power consumption, network management

**Project Necessity:** Today, the use of electric vehicles around the world is increasing and our country, Iran, and we will see this increase in the near future. The most important challenge in discussing electric vehicles is their power supply, so that if the charging process of electric vehicles can not be well managed, electric vehicles can be a threat to the electricity grid. Implementing an intelligent network for charging electric vehicles is an idea that can turn this threat into an opportunity. But the electric car charging network needs an integrated telecommunications and control network that can meet its communication needs. In this plan, after reviewing and identifying the existing infrastructure or taking action in the country, a suitable architecture for the implementation of the telecommunication network and intelligent charge control of electric vehicles in Iran has been introduced.

**Project Goals:** With the addition of the topic of electric vehicles, a new area of energy consumption will gradually be added to the global electricity distribution network, and that is charging electric vehicles. Due to the multiplicity of these vehicles, their charge management will also require their own infrastructure. One of the main goals of the project is to use the current infrastructure to realize this network. These infrastructures are receiving appropriate information in the field of car charging requirements, the amount of energy required, forecasting the requirements, the current state of the network and many other things, all of which are in the field of communication related to charging electric vehicles. Therefore, first, these communications and the protocols in them must be identified and reviewed, and the pilot implemented around the world that work in this field must be identified and evaluated. Then, the developed standards should be carefully examined and evaluated in order to be measurable in terms of operationalization in the country. Another goal is to bring together these standards, pilots, and existing open source software and hardware devices and equipment to make everything needed in the field of electric vehicle charging communications available. In the next step, according to the electricity distribution network and the

management and implementation of the smart energy network in it, the appropriate solution should be selected for implementation. Therefore, first, the current and future status of the electricity distribution network should be identified, and finally, by it, a suitable solution in the field of charging electric vehicles, appropriate standards for it and other technical details should be designed and evaluated. It is natural that the presentation of a test scenario to review the implementation of the selected standards in the field of car charging can also lead to the approval of the correct implementation of the proposed solution or the selected standard. Finally, by simulating the final solution, it can be evaluated more accurately and the remaining minor or technical issues to be implemented can be addressed.

**Abstract:** This report includes detailed activities of the project "Study and review of specifications and technical requirements of telecommunications and control of communication links of electric vehicle charging station and electricity distribution network and charging station for electric vehicles". In this regard, first in the first part to recognize the communications of the electric vehicle charging area and extract its requirements and standards, then in the second part to study and study the communication standards of the electric vehicle area, in the third section to extract and review various solutions Open source, review of implemented tools and pilots, and finally in the fourth section, the solution and architecture are designed based on the existing infrastructure in Iran.

### **Steps and Methodologies:**

- Understanding the architecture of electric vehicle charging network
- Understanding the architecture and topology of communications in the field of electric vehicle charging networks
- Understand V2G communications and related protocols
- Extraction of communication security requirements in the field of electric vehicle charging
- Extraction of various communication standards in the field of electric vehicle charging
- Preparation of phase report
- Study and review of standards in the field of communications of charging station - electric vehicle and charging station - distribution network; Per standard
- Provide conceptual design and block diagram of telecommunication and control systems and subsystems for each standard
- Specify the relationship between messages and standard functions
- Perform reliability and information security analysis for each of the standards
- Summarize each standard in terms of comprehensiveness, comprehensiveness, security, complexity and adaptation to Iran's infrastructure
- Preparation of phase report
- Extraction of various open source or commercial solutions and protocols in the field of electric vehicle charging
- Review of pilot implemented worldwide
- Investigation of communication and telecommunication devices and equipments in the field of electric vehicle charging
- Checking the data transfer system in the fuel card system and gas stations
- Preparation of phase report
- Identification of existing infrastructure in the field of electricity distribution in Iran
- Provide a suitable architecture for charging electric vehicles based on the existing electricity network infrastructure
- Selecting or designing appropriate solutions and standards for charging electric vehicles based on existing power grid infrastructure
- Review and submit a report on the selection of usable and appropriate specialized software
- Provide a preliminary report to verify compliance with relevant standards
- Preparation of phase report

### **Main Results (technical outputs, patents, papers, books, reports, etc.):**

In this project, various private and public charging scenarios and the requirements of each were discussed. After that, the types of possible rechargeable modes based on the charging rate were introduced and examined. Based on this

information, the smart car charging scenario and the overall architecture of the smart charging network were introduced and reviewed. Finally, a general architecture of the smart charging network was introduced. Based on the architecture obtained from the electric car charging network and the actors participating in this network, all the communications in this network as well as the requirements and characteristics of these communications were discussed. The concept of security, its requirements at all levels of communication of the smart charging network and the security requirements of the applications discussed in the smart charging network were stated in the third chapter of this report. The most important telecommunication standards in the field of various types of communications in the intelligent charging network of electric vehicles at all levels were introduced based on previous chapters in the fourth chapter, and then each of these standards were examined in terms of scalability, adaptability and interoperability. In this regard, the technical report of the project was completed and an article entitled “Presenting the appropriate architecture for the implementation of telecommunication network and intelligent charge control of electric vehicles based on existing infrastructure in Iran” at the conference Energy Intelligent Networks <sup>9^</sup> in Tehran - <sup>٢٧</sup> and <sup>٢^</sup> Azar <sup>9^</sup> that was held at Sharif University of Technology.