LARGE SCALE ELECTRIC POWER DISTRIBUTION AND TELECOMMUNICATION SYSTEMS SURVIVABILITY

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Introduction

The vulnerability of electric power distribution systems has been traditionally associated to physical equipment, such as substations, generation facilities, and transmission lines. Nowadays, a potential additional source of unavailability of electric power distribution systems is related to the fast introduction of complex information systems supporting technical and commercial activity of the several actors active in electricity marketplace. Most notably:

- The widespread and increasing use of Supervisory Control and Data Acquisition (SCADA) systems as part of the electric power distribution systems. Normally, SCADA systems make use of commercial-off-the-shelf (COTS) hardware and software and provide connections to other company networks. The reliability of these components for highly available systems, such electric power distribution systems, is an issue.

- The rapidly proliferating industry-wide information systems, some of which mandated by regulatory bodies to facilitate competition, are based on open-system architectures, centralised operations, increased communications over public telecommunications networks and remote maintenance. The usability of this type of architecture for highly critical systems, such as electric power distribution systems and telecommunications network, is an issue

Taking advantage of the speed, efficiency and effectiveness of computers and digital communications, electric power distribution systems are increasingly connected to information and communications networks, including Public Telecommunications Network (PTN) and Internet, in a typical configuration of largely distributed and open systems-of-systems, multi-jurisdictional and unbounded. Rapidly increasing complexity and increasingly software driven and remotely managed and maintained PTN increase the possibility for unpredictable threat and espouse to cyber attacks. Vulnerability of PTN and recovery policy from a external attacks and natural disasters is an issue.

All such aspects contribute to form highly complex systems difficult to design and defend. New properties, that are a consequence of the interaction between components, subsystems and systems (emergent properties), have to be understood, represented and faced. Survivability, the availability of critical functions and services after accidental events or intrusions, is an emergent property of large scale electric power distribution and telecommunication systems. Survivability depends on the characteristics of security, integrity, reliability and performance.

Scope and Objectives

The objectives of the project are to apply and enhance methods and develop computerised tools to help systems' development in order to guarantee the survivability of multi-jurisdictional and unbounded electric power distribution systems, linked to information and communications networks. The methods will concentrate on the architectural, control, communication, timing and human aspects (including human-machine interface and decision support) of these systems. Special attention will be devoted to the development of decision support systems to support operators for crises management in case the system will be subject to a threat or a deliberated attack. In order to achieve the above objectives, the following tasks will be undertaken:

- To understand and characterise the nature of the problems of systems-of-systems survivability, with particular emphasis to multi-jurisdictional and unbounded electric power distribution systems, linked to information and communications networks. To this purpose, this task will start by analysing specific application domains, in order to define high-level "survivability" properties for this type of systems. One of the application domains will concern energy trading, the other crises management in telecommunication and electric power distribution systems network.

- To evaluate if existing testing approaches can be extended in order to guide the introduction of new components (possibly COTS) in the system in such a way to maintain the survivability properties. Notion of test case should be revised in order to take into account interconnections and composition.

- To apply and enhance methods and develop pilot version of computerised tools relevant to fault propagation analysis and vital requirements definition, in order to establish a workable characterisation of affordable dependability of systems-of-systems, that could guarantee the quality of services against predictable and unpredictable cyber attacks.

- To apply and enhance methods and develop pilot version of computerised tools for systems-of-systems dynamic behaviour simulation and overall systems-of-systems validation.

- To develop pilot version of computerised tools to support decision making process during crises management following a threat or a deliberated attack to different components of the system-of-systems to restore and guarantee the quality of the services.

Background of the authors

Authors have large experiences in different fields important to Survivability, from critical infrastructure protection and crises management to large scale systems dependability measurement and assessment; using formal methods to analyse survivability, intelligent decision support systems for crises management.

Contact persons

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