Protection of Critical infrastructurE in Smart Cities

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Critical infrastructure is envisioned to be one of the most challenging security problems in the coming decade. Critical infrastructure include a broad range of cyber-physical systems such as the smart grid, water systems, or even transportation systems that lie at the heart of smart cities. One key challenge in critical infrastructure protection is the ability to allocate resources, either personnel or cyber, to protect these infrastructures while maintaining the overall well-being in a smart city.

For example, if a city wants to allocate resources to protect some of its critical infrastructures, it must take into account the fact that these infrastructures can have multiple, possibly interdependent vulnerable points. Moreover, one must factor in the fact that critical infrastructures play different roles in a given city or nation; and, thus, these roles determine their criticality. Indeed, resources must be allocated to infrastructures based on how vulnerable they are and how critical they. However, in practice, there is a lack of exact information about vulnerability and criticality levels. For instance, every infrastructure owner can claim that its infrastructure is the most vulnerable/critical and that it must be allocated more resources.

To address this problem of resource allocation for critical infrastructure protection, we are looking at new tools from contract theory, a powerful mathematical framework that deals with resource allocation in the presence of uncertain or asymmetric information. In particular, we consider an agency's control center (CC) that is used to design contracts and offer them to owners of infrastructure. A contract can be seen as an agreement between the CC and infrastructures using which the CC allocates resources and gets rewards in return. Contracts are designed in a way to maximize the agency's overall security benefits and motivate each infrastructure to accept a contract and obtain proper resources for its protection. In our recent work, which appears in IEEE GLOBECOM, we showed that using such a contract-theoretic model, we can properly and optimally allocate resources, in the presence of information asymmetry between the agency and the infrastructure owners. Using these preliminary results, in future work, we plan to investigate how interdependencies between infrastructures impact the resource allocation process and how such a process can instill resiliency to a smart city's set of critical infrastructures in face of failures due to natural disasters or malicious attacks.