Insight on the Strategy of Cyber Deterrence Through Game Theory

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Purely defensive operations – by themselves – are insufficient for protecting both cyber and cyber-connected assets. The torrent of successful cyber-attacks proves that additional measures are required. At the strategic level, one possible course of action is to develop an effective, clear, and credible cyber deterrence policy. Such a policy would deter cyber-attacks by disincentivizing potential adversaries through mechanisms such as punishment, denial, and deception.

While the incentive system of classical (mostly nuclear) deterrence are well understood, the cyber domain exhibits several novel issues. For example, in the cyber domain actors do not know the capability of one another. While each party may be able to signal their capability, the signals are often unverifiable. Additionally, attribution techniques are imperfect and findings uncertain. Other novelties include the fact that retaliations can be in the cyber domain or kinetic domain, overt or covert, and either persistent or impulsive. As a result, there is the potential for horizontal and vertical escalation with the possibility of misunderstandings. Adding further intricacy, the use of a cyber weapon risks rendering it no longer useful. Consequently, the threat of retaliation must consider the cost of using an exhaustible weapon.

To understand these novel phenomena, we have built a game-theoretic model (shown through the tree below) that investigates the implications of unverifiable capabilities and imperfect attribution. The benefit of our model is that it is both mathematically rigorous and real-world relevant to cyber deterrence. Importantly, our model provides a formal framework for analyzing additional elements of cyber deterrence and its implications for a national cyber deterrence strategy. Our initial examination on the potential benefits of signaling capabilities has found opportunities for strengthening deterrence.