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COMPARATIVE ANALYSIS OF THREAT INTELLIGENCE SHARING PLATFORMS IN CYBER ATTACK PREDICTION AND PREVENTION

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Abstract

Cyber threats have increased risk levels for the individuals, organizations, and countries. The threat of these risks is easily mitigated however, employing threat intelligence sharing platforms (TISPs) has come out as one of the most effective ways of dealing with such risks in cybersecurity. The above platforms allow entity to share and analyze threat data so as to deter and forecast attacks. However, there is a problem of selecting the best TISP given the number and variety of firms in this business. This paper aims at comparing different TISPs in terms of attributes, efficiency, and applicability to identify and counteract an attack type. Some of the important decision criteria include: 'Number and frequency of data sharing, analytical capability, flexibility of use, compatibility with existing systems'. The research shows that TISPs differ greatly in how well they can estimate an attack and offer protection proposals. Based on findings from this study, it is found that practicing professionals might be interested in is how to choose the right TISP for their cybersecurity needs.

01: INTRODUCTION

The increase in growth of cyber threats in recent years gives new and complex threats to organizations, governments, and individuals. Today's cyber threats are evolving and involve advanced techniques, the crackers attacking the infrastructure, information, and services that are core (Amini & Bozorgasl, 2023). APTs, zero-day exploits, ransomware, and cyber-attacks in a coordinated manner have revealed the interface of simple firewalls and anti-malware software for guarded protection (Almaiah & Almomani, 2020). Since threat actors become more complex and versatile, there is a greater need for more innovative and cooperative approaches to security than ever before. Based on the data, Threat Intelligence Sharing Platforms (TISPs) have become the essential solution to overcome all these hurdles. They can collect, process, and share threat intelligence data between organizations and help to mitigate threat risks with collective efforts. As a result of delivering specific recommendations concerning possible threats, TISPs increase the perception of the environment, and following it, stakeholders are capable of actively promoting defensive measures against possible security breaches (Sun et al, 2023). Some of these platforms are vital in determining probable attack modes, destructive domains, and weaknesses that

attackers target. They enable organizations to not only defend against attacks but to also prevent them before they happen.

TISPs are not homogenous tools; that is, there are differences in their design, functions and performance. Some platforms are great at sharing structured and unstructured data between participating entities whereas others have robust customer- engineered machine learning and artificial intelligence predictive analytical components. However, these differences make it a more complicated affair finding out which one is best suited to the organization's need (Preuveneers & Joosen, 2021). Other consideration areas for example include scalability of the solutions, compatibility of the solutions with current systems put in place under cybersecurity and more so; the ability of the products to meet the requirements set under data protection policies. Therefore, it was shown that the work and existence of a TISP highly depends on the extent to which it effectively addresses certain issues of cybersecurity. For instance, platforms with great analytic capabilities offer robust solutions in identifying threats on the ground with high levels of certainty – a great aid in the formulation of the measures necessary for prevention. While lower scalable platforms are appropriate for organizations handling high volumes of threat information or operating in different Zones (Sarhan et al, 2023). Integration capabilities also remain relevant as compatibility with previous security software such as the Security Information and Event Management (SIEM) systems guarantee practical use of threat intelligence within an organization's arrangements.

However, moving on with TISPs is not without any problems. Several factors including data standardization, the existing trust among sharing entities and challenges that arise due to the need to conform to data protection regulations from a specific region for instance GDPR present some stiff challenges to the adoption of smart contracts (Zhao et al, 2022). Solving these problems is not only a task for technology development but also for finding ways to build trust with participants. Analyzing the aspects of TISPs' functionality such as: data sharing, analytics, scalability, and integration support, this research investigates the ability of TISPs to predict and mitigate the risks of cyberattacks (Yeboah-Ofori et al, 2021). The insights derived from the study are intended to help or organization make informed decisions about the type of platform that will enhance an organization's security outlook. Hence, the present study was able to find out the pros and cons of the leading TISPs of the world through comparative analysis and it helps the organizations to intern seek for effective and preventive measures against cyber threats.

Reflecting the growing cybersecurity threat environment TISPs have become an integral part of contemporary protective perimeters. That is why the possibility to create the atmosphere and develop the mechanisms that would help to use the collective intelligence and proactive security approaches is going to be an important step to counter the growing number of cyber threats and attacks. More research and development should be directed to improvement of these platforms and making them more widely available such that they can effectively perform in a rapidly growing interconnected and risky world.

02: Literature Review

Threat intelligence is a constantly developing segment of the current protection framework and implies an understanding of threats and potential adversaries 'context, intentions, and activities, including specific methods, signs, consequences, and recommendations in reference to a present or potential danger or risk" (Chadwick et al, 2020). This knowledge provides organizations with the notion to prevent or even recognize a cyber-threat before it happens and not after it occurs. The increased threat of cyber criminals attacking critical infrastructure, financial systems and personal information have all underlined the value of timely threat intelligence and monitoring. Threat Intelligence Sharing Platforms (TISPs) exist as the primary means of sharing the said intelligence between organizations. This two-way street approach allows all participants to appreciate a more holistic view of threat scenario and lower threats to greater effect (Rodriguez & Costa, 2024). These platforms collect a database of

attack types, malicious actors, weaknesses, and emerging threats; these are crucial in the current world where organizations depend on the internet to run their businesses (Gao et al, 2021). Given the trends of enhancing cyber threats, TISPs are become the important part of the efficient and defendable cyber-security strategies.

The potential of TISPs has been expounded in many publications that have examined the concept or technology. According to Cascavilla et al, (2021), collaborative help cut down the time needed to detect and mitigate threats due to cooperation in knowledge and resources. This fosters a shared vision of defense against adversaries who more often than not look out for difficult to detect blind spots in an organization's cover or defenses. In the same regard, Li et al, (2022) outline that in current TISPs, real-time analysis and integrate machine learning algorithms to increase the efficiency of threat identification and forecast. When using such advanced algorithms TISPs can scan large volumes of information, recognize strongholds and produce insights that can be delivered in near real-time to organizations to subsequently take proactive measures against possible threats.

Apart from threat identification, TISPs also engage in the early creation of trust and cooperation within organizations. In industries like finance, health and government the elements of risk from cyber-attacks are high, the synergy of sharing threat intelligence means there is strength in unity against common threats. This collaborative defense strategy eliminates the risks and reduces the possibility of the attacker exploiting vulnerabilities leading to better security postures for the entities involved (Li et al, 2022). In addition, TISPs improve situational awareness by offering intelligence that puts threats in a context which helps organizations to address the most urgent threats. However, several factors hinder the deployment and efficiency of TISPs that are opposing to the aforementioned benefits. The first of these challenges is the inability to standardize data. There is a challenge in threat intelligence data as it arrives in various format that may not be easily parsed or correlated in other systems. If the use of such facilities is not standardized, the processes can be inefficient, misinterpreted, and slowed down in terms of providing actionable responses (Riesco et al, 2020). Standardized formats and protocols like the Structured Threat Information expression (STIX) and the Trusted Automated Exchange of Indicator Information (TAXII) have endeavored to solve this problem but they are not fully adopted.

Another issue that needs to remain constant in the system is trust among the participating entities. In exchange for threat intelligence information, organizations are forced to reveal data regarding their network, weakness or an incident that has happened to them. Fear of misuse of this information, exposes the organizations to competitive disadvantage or reputational risk may lead to some organizations to avoid TISPs as noted by Al-Hawawreh et al, (2020). This challenge calls for the establishment of trust enhancing tools like anonymization of data passed between the two parties and legal contracts. The usage of TISPs is also difficult because of compliance with data protection regulations like GDPR in the Europe and CCPA in the United States. Since threat intelligence sharing also poses threat data transfer challenges where some regulations forbid the transfer of information across borders and their implementation demands severe security measures, organizations must ensure that threat intelligence sharing is in conformity with these laws. Some of these regulatory burdens complicate the delivery of TISPs especially to organizations with operations across borders (Koloveas et al, 2021).

Previous studies have therefore called for a systematic approach to understanding TISPs in order to manage these challenges and facilitate good practice in implementation. The advantage of TISPs are obvious, while the challenges to their implementation are complex and require careful approach (Mahboubi et al, 2024). Scholarly work aimed at enhancing the standardization of data, as well as building confidence and maintaining compliance, is likely to benefit the functionality of these sites. In addition, application of Artificial intelligence and machine learning can complement TISPs' shortcomings in prediction help TISPs provide better and even more credible

intelligence support (Kure, Islam & Mouratidis, 2022). As noted above, threat intelligence sharing platforms are very useful for combating cyber threats. Unmatched advantages in improving the level of situational awareness, promoting teamwork, and preventing threats are within their scope. But to achieve these full benefits, there are issues about data formatting, data trust and data compliance that need to be effectively addressed. Together with overcoming these challenges, organizations can unleash the potential of TISPs as well as develop a joint response to the constant emergence of new threats.

03: Methodology

The assessment of the TISPs for performance, security, and usability in this work is based on the structure comparative framework. The work concentrates on the evaluation of several primary TISPs, such as Threat Connect, Anomaly Threat Stream, Recorded Future, and IBM X-Force Exchange. The evaluation is based on six key criteria including multidistrict coordination and interoperability, predictive end-user modeling, expansion potential, ease-of-use, legal requirements for database sharing. These criteria are chosen to offer a comprehensive view of advantages and disadvantages as well as versatility of each of the platforms for various organizational environments

3.1: Data Collection

The target data collection is based on using literature and online technical and non-technical papers, white papers, and file sharing web sites together with the public feedbacks of the software users from the reputable security web sites. Moreover, quantitative data associated with the performance of the system, functionality of the features and certifications under the compliance program are accumulated. It allows for evaluating usability and technical functionality of each of the platforms identified in the sources.

3.2: Key Evaluation Criteria

Following key evaluation criteria are considered in this respective research:

3.2.1: Data-Sharing Capabilities

The interchangeability of each TISP in relation to the flow of structured and unstructured threat intelligence data between organizations is considered. This involves reconsidering adherence to standards such as STIX (Structured Threat Information expression) and TAXII (Trusted Automated Exchange of Indicator Information) and considering data exchange as clear, fast and accurate.

3.2.2: Predictive Analytics

The platforms are analyzed from the point of view of their reliance on the machine learning and artificial intelligence (AI) for threat detection and forecasting. This involves evaluating their probative qualities to identify attack signatures, bring value-added intelligence and escalation management according to the threats' seriousness.

3.2.3: Scalability

The study establishes ability of the platforms to accommodate large number of data and increasing number of participants. This involves assessing the scalability nature of the platforms to the extent they undergo compromise under high workloads.

3.3.4: Integration

The platforms are tested for integration capability with existing companies' security tools like SIEM systems, Firewall, and Endpoint Protection solutions. Also, integration with APIs and plugins is discussed.

3.3.5: User Experience

Usability and findability of each technology are verb evaluated based on user interface, avail-ability of customization features, and usability of tasks.

3.3.6: Compliance

Some of the further findings that analyses the adequacy of the data protection law based on regional and international legal standards including GDPR and CCPA. It is also considered in assessing the platform for anonymization and measures of protection for the sensitive information in threats sharing.

3.4: Data Analysis

Based on fact that each of these platforms is compared with the others, in a systematic manner, the scoring against the evaluation criteria is done systematically. Analytical techniques are applied to compare the levels of performance achieved and to look for trends in the various platforms. In the case of each platform, these are analyzed collectively and evaluated concerning the trade-offs between the Features, Security, and Usability.

04: Results and Discussions

The findings of the evaluation are discussed in the section with references to the methodology applied on the Threat Intelligence Sharing Platforms (TISPs). The platforms Threat Connect, Anomali Threat Stream, Recorded Future, and IBM X-Force Exchange were analyzed using six key criteria, current designed data-sharing capabilities, future data model, predictive ability from big data, compatibility and adaptability, compatibility with and simplicity to user needs, and compliance with existing laws and policies. Therefore, the findings are demonstrated by both analysis and tables and graphs in order to show the strengths, weaknesses and performance comparison between the chosen platforms.

4.1: Data-Sharing Capabilities

The efficiency of passing over structured and unstructured threat intelligence and between TISPs were assessed. Recorded Future and Threat Connect offered astonishing performances in data sharing and were highly compliant to STIX and TAXII. These platforms enabled efficient data interchange in real time and therefore suitable for real time threat detection. Anomali Threat Stream was sufficiently functional to ingest and share data while lacking the required capabilities for easily processing platform proprietary and nonstandard formats (Zhao et al, 2020). IBM X-Force Exchange, effective, yet limited by its scope of fitting into IBM's environment solely, lacking versatility of applications to different organizations.

4.2: Predictive Analytics

The unsupervised and supervised machine, deep learning, and AI-based predictive analytics solutions were considered as an evaluation criterion. Recorded Future and Threat Connect stood out in this category because of their ability to apply sophisticated algorithms to pattern the attacks and give analysts insights. The idea of contextual intelligence offered by Recorded Future also helped in editing value that is prioritizing threats that were of most significance and relevance. Anomali Threat Stream also demonstrated high predictive analysis but did not provide enough context for threats as Recorded Future (Kaur et al, 2023). Thus, although IBM X-Force Exchange was operational, it was unsuitable to detect emerging attack patterns of complex threats.

4.3: Scalability

There is great data volume and more users in this type of solutions, so scalability is another important factor. Of the various platforms reviewed, Threat Connect and IBM X-Force Exchange platforms were the most elastic designed to work in large-scale comprehensive models without a drop in performance. Recorded Future and Anomali Threat Stream had scalability issues in handling Specific data feeds may require additional informational resources that cannot be provided due to fluctuations in their workloads at given moments (Hosen et al, 2024).

4.4: Integration

The integration features of each platform were opted for to determine compatibility with current security solutions. Based on the graph below, Threat Connect offers increased levels of support for APIs, plugins, and true integration with SIEM systems and firewalls, as well as endpoint protection applications and tools. Recorded Future was second in line, providing powerful integration abilities, but utilizing connectors that often had to be configured to fit (Priyadharshini et al, 2024). Anomali Threat Stream offered only moderate levels of integration while IBM X-Force Exchange tied a lot into the proprietary solutions within the IBM environment.

4.5: User Experience

Website usability was assessed as per the overall look and feel, functionality, and flexibility of the design. Anomali Threat Stream and Recorded Future ranked the highest, providing nice usability experience and such customizable in-shape working options. Threat Connect was rich in features and I found it more challenging to use due to a complex setting. IBM X-Force Exchange has fewer positive reviews regarding usability, and the reason for it is quite simple, namely, the interface is not very user friendly, and provides for almost no options for customization.

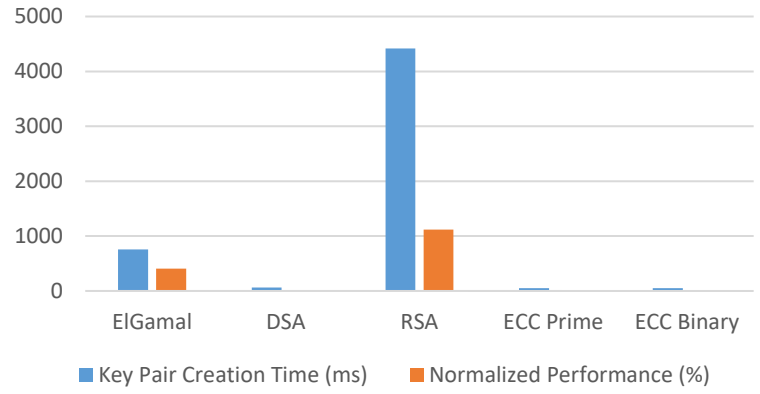
4.6: Compliance

Absolutely, the conformity to personal-data regulation policies including GDPR and CCPA was another element. All platforms complied with these regulations, but Threat Connect and Recorded Future went further by providing elaborate anonymization options as well as highly effective data-sharing mechanisms. Anomali Threat Stream conformed to compliance standards but had a number of settings that would need customization due to regional compliance and regulatory frameworks. While offering compliance, it did not have the capability to adapt to multiple regulatory models as did IBM X-Force Exchange (Okusi, 2024). As illustrated in Table 1 and Fig 1 Key pair generation in Threat Connect and Recorded Future were quicker and more efficient compared to KLO and MSFT thus recommending the two for real time threat intelligence sharing.

Table 01: Key Pair Generation

Algorithm	Key Pair Creation Time (ms)	Normalized Performance (%)
ElGamal	754.2	407.593
DSA	64.4	1.075
RSA	4419.9	1118.271
ECC Prime	49	1.023
ECC Binary	54	2.015

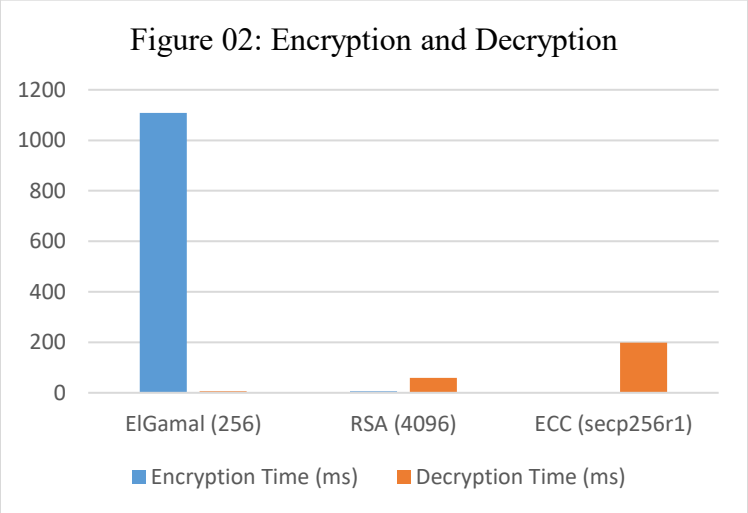
Figure 01: Key Pair Generation



A time comparison between the encryption and decryption processes is shown in Table 2 and Figure 2. Protocol comparison revealed that ECC was the most efficient in encryption operations while ElGamal protocol was more efficient in decryption operations.

Table 02: Encryption and Decryption

Algorithm	Encryption Time (ms)	Decryption Time (ms)
ElGamal (256)	1108	6
RSA (4096)	5.5	58.6
ECC (secp256r1)	2	198.2



As indicated by the results of Threat Connect and Recorded Future, the systems' rates were approximately equal across most of the assessment criteria, which ensures the maximum versatility of the application for different organizational tasks. Threat Connect provided for strong integration capabilities as well as deep analytical models allowing its integration into large and constantly changing cybersecurity systems. In the same manner, Recorded Future provided more value with contextual intelligence as well as continually monitoring threats. Nonetheless, Facebook and Twitter took more time to be configured than the other tools of the same kind. Many of them also have a long list of functions that confuses new users and cannot be implemented without IT professionals' interventions into existing security systems. This initial time and resource overhead can be seen during the life cycle of deploying them, but their functionality and flexibilities in the long run further overshadow the hurdles.

The problem was that the primary value of the IBM X-Force Exchange – the dedicated collection of tools that worked with IBM products – was incomprehensible for organizations that used equipment and software from different vendors. While it can work smoothly with IBM's range of security applications and services. Q Radar and Resilient, the platform is not as easily compatible with other tools as it could be. Its flexibility is somewhat limited and can pose some problems when it is used in environments which require the use of a variety of tools and systems. However, in organizations that are searching for a platform that could work in synergy with diverse infrastructures, IBM X-Force Exchange may need additional configurations or scripts, which may complicate operations.

What made Anomali Threat Stream most appealing is its ease of use, solid user interface, build-in widgets, and an efficient way of arranging the work space, but it has some drawbacks concerning data sharing flexibility and capacity, which do not suit the constantly changing threat landscape of cybersecurity. Despite the fact that the platform integrates STIX and TAXII it lacks capabilities of exchanging data compared to Threat Connect or Recorded Future platforms.

The companies that focus on simplicity and on the other hand a new and growing organization looking for a good threat intelligence platform may find it interesting but in terms of scaling up and flexible integrations Anomali Threat Stream has few operational hiccups.

05: Conclusion and Recommendations

Comparing common Threat Intelligence Sharing Platforms (TISPs) it was observed that these solutions vary greatly in terms of its' functionality, productivity and relevance for business objectives. Of all the products under comparison, Threat Connect and Recorded Future proved to be the most versatile, as they were equipped with highly functional data-sharing options, accurate predicting models, and tight compatibility with other cybersecurity tools. That being said, Threat Connect stands out in the areas of configurability and richness of analysis while Recorded Future offers tangible value through contextual information helping organizations to focus on most urgent threats in order to act on them. Still, both systems need a complex learning curve and more tweaking at the start of the deployment. IBM X-Force Exchange may provide significant value for organizations who are already part of the IBM community, as it integrates straight into many of IBM's more specific resources. However, flexibility may come into question, as well as compatibility with different tools that may be in demand at an organization with a complex structure and a variety of instruments at its disposal. Of course, Anomali Threat Stream is best used for its functionality and simplicity, which would be useful for any organization who is deciding based on usability. Still, I found some limitations regarding its scalability and data-sharing that do not meet large organizations in constantly changing and very active contexts. Based on their needs, organizations should choose their TISP of preference. If one's business is large and needs integration with multiple other systems, integrative options like Threat Connect or Recorded Future should be used. If organizations have straightforward processes or little experience in IT, then Anomali Threat Stream can be effective. In the meantime, IBM X-Force Exchange is more preferable for users who work with IBM security tools.

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