Software Mobile Agent Migration: A Review

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Abstract: An agent is a software package component that is autonomous with intelligence, mobility whereas having ability to collaborate well by alternative hosts and intelligent Agents. Agents hold responsibilities without constantly consulting the hosts with a dedication, on their behalf. Mobile Agents can effectively co-ordinate among agents, users and software hosts. A searching agent that is competent to retrieve preferred information on behalf of the users. The agent is sent away to carry out the look for off-line as well, after being told what to search for. A Mobile Agent is a software program which is generally written in scripting language. Mobile agent has unique ability to travel from one machine to another machine in a heterogeneous network to perform computational problem or gathering required information. The focus of this survey is providing Different Security Techniques that are proposed by many Researchers. Mobile Agents are capable of performing tasks which require plenty of configurations. These days, mobile agents are wide employed in variety of applications owing to their intelligence. Though they possess intelligence however exposing them to the distributed systems increase threat to mobile agent security. There are a unit variety of attacks that are known in mobile agent systems. We then give a detailed analysis of different techniques that have been proposed by researchers for preventing attacks as well as detecting them.

Keyword- Mobile Agent, Security Techniques, attacks, Security classifications

I. INTRODUCTION

Mobile Agent is a Software Program That Runs from one machine to another for gathering the information and execution of the stored information.The programs are loaded and the tasks are executed in the way they are programmed after reaching to destination. Mobile Agent on overall network interacts with other agents while moving within the environment. Mobile Agent executes their operations within the mobile agent platform. Mobile Agent Platform is responsible for send, receive, execute and transfer of mobile agent hence mobile agent platform act as a medium for MA. In which Platform an agent is initialized is called Home Platform for that Agent and this platform is most well grounded from all. A Mobile Agent requires an execution Platform to get instantiated, migrate and get executed.The Platform contains all the resources required for the Mobile Agent. A Mobile Agent moves from one platform to another in order to collect and to process data.

II. RELATED WORK

Table 1 includes the various research work in the field of Mobile Agent Security and there main objective is included with the approaches involved.

Table: 1 related work on various approaches of mobile agent security

S.No.	PAPER	PUBLISHER	YEAR	OBJECTIVE
1	A novel trust-scoring system using trust ability co-efficient of variation for identification of secure	AdriJovin John Joseph, MarikkannanMariappan	2018	This paper focuses on the trust scoring system which measure the trustworthiness of a platform based on a metric term Trust Score.

	agent platforms[1]			
2	Advanced mobile agent security models for code integrity and malicious availability check[4]	] S.Venkatesan, C.Chellappan, T.Vengattaraman, P.Dhavachelvan, A.Vaish	2010	Extends the Mobile Code Toolkit of the Perpetuum Mobile Procura project for integration with an SNMP agent. Mobile agents are provided with management capabilities to dynamically access and extend the XMS-SNMP agent's MIB
3	Security of mobile agents and platforms: Securing the code and Protecting its Integrity[6]	Mohammad RazaulKarim	2018	Describes an overview of the security issues related to the mobile agent paradigm and introduce a new framework for improvement of mobile agent security in order to secure the code and protect its integrity.
4	A hierarchical access control scheme based on Lagrange interpolation for mobile agents[7]	Tsung-Chih Hsiao, Zhen-Yu Wu, Tzer-Long Chen, Yu-Fang Chung and Tzer-Shyong Chen	2018	This method use a function defined by Lagrange polynomial to compute decryption key. Each host will be give a decryption key to access the confidential document by inputting a secret key into an interpolation function which is generated from Lagrange interpolation,
5	Mobile Agent Applications within Intrusion Detection Technology[10]	NishaVerma, Anjani Kumar	2011	This Paper focuses on the advantages and disadvantages to apply the mobile agent technology to intrusion detection system.
6	A new approach to intrusion detection using Artificial Neural Networks and fuzzy clustering Expert Systems with Applications[9]	Gang Wang , Jinxing Haob,c, JianMab , Lihua Huang	2010	Propose a new intrusion detection approach, called FC-ANN, based on ANN and fuzzy clustering. Through fuzzy clustering technique, the heterogeneous training set is divided to several homogenous subsets. Thus complexity of each sub training set is reduced and consequently the detection performance is increased.
7	Optimize Security solution for mobile agent security: A Review International Journal Of Engineering And Computer Science [18]	Sachin Upadhye and P.G.Khot	2013	Focuses on the optimization of computation cost for agent platform, which appears due to complex security operations. Traditionally, a security manager is integrated within an agent platform, which performs these operations for every mobile agent visiting the platform.
8	The Use of Encrypted Functions for Mobile Agent Security[14]	Hyungjick Lee and Jim Alves-Foss and Scott Harrison	2004	Propose a new framework for Web-based distributed access to database systems based on Java-based mobile agents. The framework supports lightweight, portable, and autonomous clients as well as operation on slow or expensive networks
9	Overview of Mobile Agent Security Issues – Solutions[19]	S. SobithaAhila and Dr.K.L.Shunmuganathan	2014	Overview of the main security issues related to the mobile agent paradigm. These issues include security threats, requirements, and techniques for keeping the mobile agent platform and the agent itself secure against each other
10	Agent's security during communication in mobile agents system[20]	ChadhaZrari, HelaHachichab, KhaledGhedira	2015	Security is a very important concept in the growth and the development of the mobile agent technology. Describe model the security properties in order to protect stationary agents during their communications with visitor mobile agents.
11	Study of Latest Emerging Trends on Cyber Security and its challenges to Society[22]	Ravi Sharma	2012	Cyber Security plays an important role in the development of information technology as well as Internet services. Our attention is usually drawn on "Cyber Security" when we hear about "Cyber Crimes". Our first thought on "National Cyber Security" therefore starts on how good is our infrastructure for handling "Cyber Crimes"
12	A Review of security	Mandeep Kaur and Sharad	2017	Discusses various types of attacks such as

	Techniques for Mobile Agents[23]	Saxena		attacks against agents, attacks against platform etc.give a detailed analysis of different techniques that have been proposed by researchers for preventing attacks as well as detecting them and give a conclusion with the suggestion of appropriate countermeasure.
13	Mobile Agents in Distributed Java Agent Development Framework[11]	Timo Bayer and Christoph Reich	2017	Describe existing vulnerabilities and security gaps by analyzing the security of agent platform JADE, showing existing improvements of the confidentiality of software agents merging from one agent platform to another and introducing trusted agents and their implementation in JADE.
14	New Computing Model for Securing Mobile Agents in IP Networks[12]	Jean Tajer, Mo Adda and Benjamin Aziz	2017	Propose a new security computing model based on trusted server to avert Eavesdropping and Alternation attacks. The new protocol will be implemented using IBM mobile agent platform, Aglet
15	N-grams Based Supervised Machine Learning Model for Mobile Agent Platform Protection against Unknown Malicious Mobile Agents[21]	PallaviBagga, Rahul Hans, Vipul Sharma	2017	Machine learning algorithms for the task of classification of mobile agent either malicious or non-malicious in a Mobile Agent Environment using a specific dataset. In particular, n-grams are used as features during the classification process.
16	FuMAM: Fuzzy-Based Mobile Agent Migration Approach For Data Gathering In Wireless Sensor Networks[24]	Huthiafa Q. Qadori , Zuriati Ahmad Zukarnain1 , ZurinaMohd Hanapi1 , And ShamalaSubramaniam, Fumam	2018	Improves network lifetime relative to the other MIP approaches. As a future work, other input parameters to FLS can be considered to evaluate the performance of FuMAM.
17	Implementation of Trust and Reputation Management for free-roaming mobile agent security[13]	G. Geetha and C. Jayakumar	2015	Trust and reputation management (TRM) is implemented to provide asecure path for free-roaming MA data protection. TRM utilizes a trust-based routing table that is constructed with a trust and reputation value. Various types of attacks, particularly colluded truncation attacks, are avoided by secure routing.
18	Mobile agents: Objective, Platforms and Architecture(The cutting edge of Wireless Technology)[26]	Sandeep Srivastava and Meeenakshi Arora	2015	Explain the objectives and properties of the mobile agents in currently used architecture and platform of mobile world from the currently used approach RPC (Remote Procedure Calling) and new approach RP (Remote Programming) of the mobile network we can distinguish the various used unused and new features of mobile agents.

III. MOBILE AGENTS CHARACTERSTICS

(a) Intelligence

Software agents use techniques from the sector of Artificial Intelligence that empower them with a good degree of intelligence and customer sense. For instance, the factor program ought to understand that folks usually don't like to move by flight that depart or reach the field late within night and therefore the agent ought to avoid booking tickets on such flights. The factor program ought to be sensible enough to cut price and organize the trip in order that the general expenditure for the trip is as low as potential while not compromising on the user's preferences.

(b) Autonomy

The agents themselves decide the sequence of actions to be performed to attain the user's task. This autonomy allows agents to control while not requiring human intervention.

(c) Responsiveness

Agents understand their atmosphere and respond in an exceedingly timely fashion to changes that occur in it. At identical time, agents mustn't merely act in response to their environment; they must be able to exhibit timeserving, goal-oriented and take the initiative once acceptable.

(d) Adaptability

Mobile agents roam from one laptop to a different within the network and execute on many machines. quality will increase the practicality of the mobile Agents perceives their atmosphere and responds during a timely fashion to changes that occur in it Agent permits the mobile agent to perform tasks on the far side the scope of static agents.

(e) Distribution flexibility

Mobile agent runs within the entire distributed system, instead of fastened at a specific location. during this approach, once required it will directly send itself or alternative required mobile agents to the specified host web site for native operation, which may improve the operational flexibility, whereas eliminate the dependence of the complicated communication protocols of the normal agent communication.

(f) Low-network data traffic

Mobile agent will filter the collected knowledge, and then extract the key knowledge. During this manner, the info traffic through the network will be considerably reduced to boost the system overall convenience.

IV. LITERATURE SURVEY

Mobile agent technology has provided several applications that got improved over ancient communicatory approaches. Security is that the main concern that remains to be improved for the Mobile Agents Application. Once Mobile agents leaves its home Platform it losses the management of its owner. Because of this, risk of attacks will increase. Figure 1 represents the different types of security techniques in Mobile Agents System:

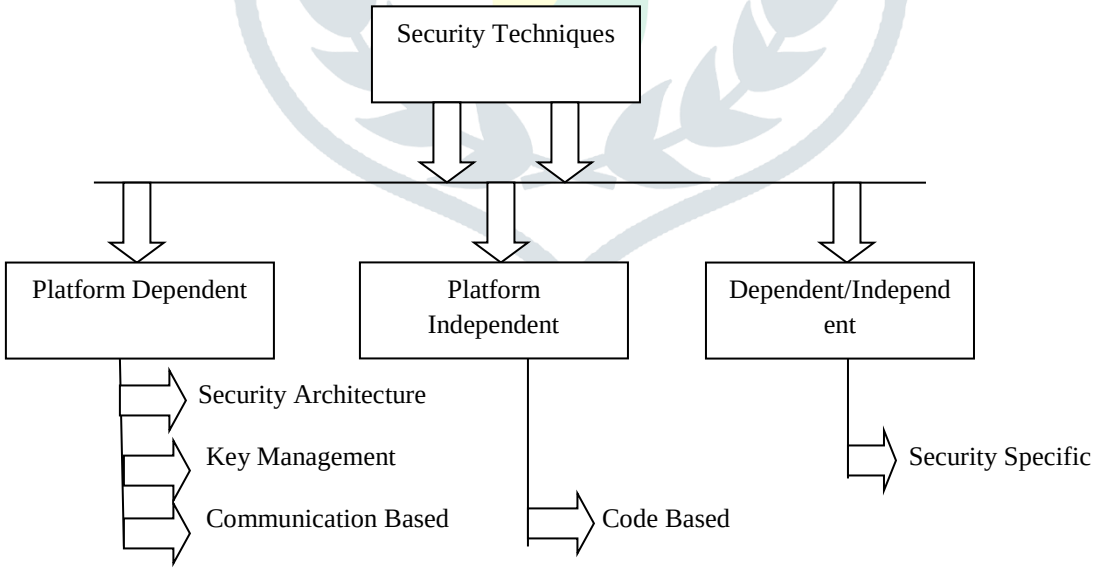

Figure 1: Types of Security Techniques

(A) PLATFORM DEPENDENT

Platform dependent techniques are those which can run in a single operating environment. This section contains those techniques which are dependent on platform for their implementation. Further it divided into three categories:

1. Security Architectures: This framework establishes trustworthy relationship among consumer and repair suppliers. The complete framework has four layers and every layer is capable of performing arts verification, authentication and integrity throughout communication at totally different level. SSL key exchange methodology is employed for providing authentication. The main purpose of this framework is institution of trustworthy relationship between 2 entities that is achieved by SSL agreement.

2. Key Management Techniques: Key Management theme is employed for reducing the key management complexness for the mobile agents. This key management technique uses the elliptical curve cryptography to extend the protection. Therefore it boosts the performance of mobile agent as a result of the overhead of sending the secret is reduced. The Keys mechanically get changed in line with time. This can be important,, since a Mobile Agent that has access to a selected resource at a selected time might not have the access to it resource at the other time. Therefore, agents will access resources only they're allowable to access. This approach is resistive to reverse attack, external collective attack, collusion attack and date alteration attack.

3. Communication Based Techniques: S.U.Guan et al.[5] given the Passport and Visa model follows the technique employed in Immigration services. The protection mechanism is entirely addicted to SAFER. This model serves latest digital credentials for authentication of host and agent. It offers effective security mechanism for on-line teams to manage the Mobile Agent migration. It additionally manages and controls the entry and exit of mobile agents throughout its execution. Hence, there's a continual observance of Mobile Agent movement that overcome the danger of the malicious infection over the death penalty platform by malicious mobile agents.

(B) PLATFORM INDEPENDENT

This section contains those techniques that are freelance of platform for their implementation. Solely code primarily based techniques are platform freelance.

(C) DEPENDENT/INDEPENDENT

These types of security architecture can be dependent and as well as independent of their platform. These techniques are explained below:

Sandbox: T.Grandison et al.[16] enforced Sandboxes within the browser using java interpreter. These square measure used for mobile agents. This security technique principally consists of 3 parts specifically class loader, security manager and verifier.

Code Signing: Reiser et al.[17] planned a unique approach i.e. Code signing that uses Microsoft Authenticode. In Microsoft Authenticode, ActiveX is employed for code signing. The system consists of a specific policy. If that policy is modified by a Mobile Agent or the other external entity, it's thought-about as a threat. It introduces a trust model to differentiate between the trustworthy authors and undependable authors.

TRUST SCORING

A Mobile Agent without delay interacts with any platform that is taken into account trustworthy. Trait may be a broad term that is extremely complicated to explain within the term of technology. For enhancing trust in mobile agent's symmetric key cryptography, signature verification technique is employed. By using knowledge based System data was encrypted into a separable whole of protection. If the information is known by the trustworthy third party via knowledge primarily based system then verification and summarization of previous task are done. When agent reaching a host, it concatenates the data generated on it with data carried by agent then encrypts them and verifying identity information. Knowledge Based System gets identity information from the trusted third party periodically. When agent comes back to host after completes its work without any attack.

Based on previous studies and inferences, trust can be defined as a summative function of Persistence (P), Competence (Cp), Reputation (Re), Credibility (Cr) and Integrity (Ig).

Table 2 describes the idea of different techniques used for securing the mobile agents as well as agents' platform

Table 2: comparisons between different techniques

Techniques Used	Prevented Attacks	Security Approaches	Comments
Trust Scoring [29]	Unauthorized approach	Persistence, Competence, Reputation, Credibility and Integrity.	Trust Ranking mechanism consumes less latent period and improves the accuracy of call of Mobile Agents
Formal Modeling[3]	Unauthorized Access	Extended Elementary Object System function	Strong Mobility and Require more refinement.
Intrusion Detection [8]	Robbery or assault	Open source Intrusion detection system tools	Increase the flexibility and interoperability of mobile agents.

Encrypted Function[14]	Attacks from untrusted hosts	PRAC, Environment key generation	Overcome the risk of Malicious infection
A Trustworthy Relationship Using Mobile Agent[30]	Unauthorized Access	Secure Socket Layer Key Exchange Method	Ensures Security and Privacy of Client Data.
Mobile Agent round-trip and network lifetime [13]	Unauthorized Access, masquerading, alteration	Fuzzy-based Mobile Agent Migration Approach	Good approach for preventing a number of attacks
Dynamic Code[2]	Alteration	Double integrity Verification Scheme, CCAP	Doesn't provide a complete solution for code integrity problem
Proof Carrying Code[15]	Unauthorized Access, Repudiation	Proof-Carrying Code	Good approach for verifying the safety policies.
RBAC[25]	Unauthorized Access	Elliptic Curve Cryptography	Good at detecting unauthorized access
Code Signing[17]	Unauthorized Access	Microsoft Authenticode	Good approach for differentiating between trustworthy and untrustworthy authors.
Machine Learning[21]	Unknown Malicious Mobile Agents	n-gram features and supervised ML approach	Ensure security of mobile agents system.
IP Tracer [12]	Eavesdropping and Alternation attacks	IBM mobile Agent Platform	A new framework based on trusted server and developed by IBM platform Aglet to prevent security issues over mobile agents
Proxy Signature Protocol[31]	Unauthorized Access	Digital Signature, RSA Algorithm	More prone to attacks with timing constraints
Platform Registry[26]	Data integrity	Travel Diary Protection Scheme and Platform Registry.	Mobileagents roam freely in open networks environment without being compromised in a malicious hosts.
Trusted Computing Environment [16]	Unauthorized Access	Trusted Computing Technology	Overcome the risk of Malicious infection

VII. CONCLUSION

After study of various researchers work in the field of Mobile Agents Security we find that security of mobile agents is main concerns in this modern era. In this paper we discussed many approaches for securing the mobile agents and as well as mobile agent's platform. There are many security techniques are discussed in this paper than can provide a secure medium for mobile agent. Different Security techniques were listed which can provide better security to the mobile agents. To improve the security of mobile agents many techniques such as trusted computing environment, machine learning, Trust scoring system, code signing etc. are currently presents.Mobile agents have drawn more attention as a fundamental technology in next generation of computing. If we talk about future work in the field of mobile agent there are lot of research can be perform for improvement of security of mobile agent system.

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