

Five Layer Security Architecture & Policies for Grid Computing System

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Abstract- In this paper we described four layer architecture of Grid Computing System, analyzes security requirements and problems existing in Grid Computing System. This paper presents a new approach of five layer security architecture of Grid Computing System, defines a new set of security policies & gives the representation.

Key words Security Architecture, Security policy, Grid Computing.

1. INTRODUCTION

State of the art and emerging scientific applications requires high performance computing [1]. It is not possible to solve large quantities of data and problems using a single high performance computer or a single computer cluster. Therefore it is required to connect distributed, heterogeneous high performance computers [6], computer cluster with high speed interconnection networks and integrate them into a high performance computing environment. This environment is known as Grid Computing.

Large scale distributed environments couple computers storage system and other devices to enable advance applications such as distributed super computing, computer enhancement instruments and distributed data mining. Grid Computing Systems results from development of application for high performance computing. It includes dynamic resource requirements, use of resources from multiple administrative domains, complex communication structures and high performance requirements. Grid Computing Systems now attracts universities, institutions, governments, male tries and big companies.

The characteristics of computational Grids leads to security problems that are not address by existing security technologies for distributed systems. The dynamic nature of the Grid can make it impossible to establish trust relationships between sites prior to application execution. In this paper we describe a layered security architecture [4] that overcomes many of the difficulties related to security [5]. We propose security policy for Grid Computing System that addresses requirements for security management of Grid Computing System. We define a new security policy of Grid Computing System and present the representation.

2. FOUR LAYER ARCHITECTURE OF GRID COMPUTING SYSTEM

Grid Computing System consist of high speed interconnection network, high performance node, operating system, Grid middleware layer, parallel programming environment and Grid application (serial and parallel applications [2]). Four layer architecture of Grid computing shown in figure 1.

The four layer model can be defined as node and interconnection layer, node system software layer, Grid system software layer and application layer.

Node and interconnection layer: - This layer is the lowest layer of the Grid Computing System. The node and interconnection layer provides the resources to which shared access is mediated by Grid protocol. It consists of high performance of computer, large-scale database server, large-scale file server, computer cluster, large communication equipment and high-speed interconnection network connecting these resources.

2.1 Node system software layer: -

This layer defines core communication and authentication protocol required for Grid specific network transactions. Communication protocols enable the exchange of data between node and interconnection layer. Authentication protocol build on communication services to provide secure mechanism for verifying the identify of users and resources. Nodes system software layer includes operating system software, large-scale database system software, large-scale file system software, cluster system software, network connection protocol large equipment driver etc.

2.2 Grid system software layer: - This layer is also known as Grid middleware layer. This layer concerned entirely with individual resources and hence ignores issues of global state and atomic actions across distributed collections. Resource management, data management, user management, task management, information services, authentication and authorization are implemented in this layer.

2.3 Application layer: - The final layer is our layered Grid architecture comprises the user applications that operate within virtual organization environment. This layer consist of Grid programming environment, other software which support direct access file and database, Grid service portal based web, many kinds of Grid applications.

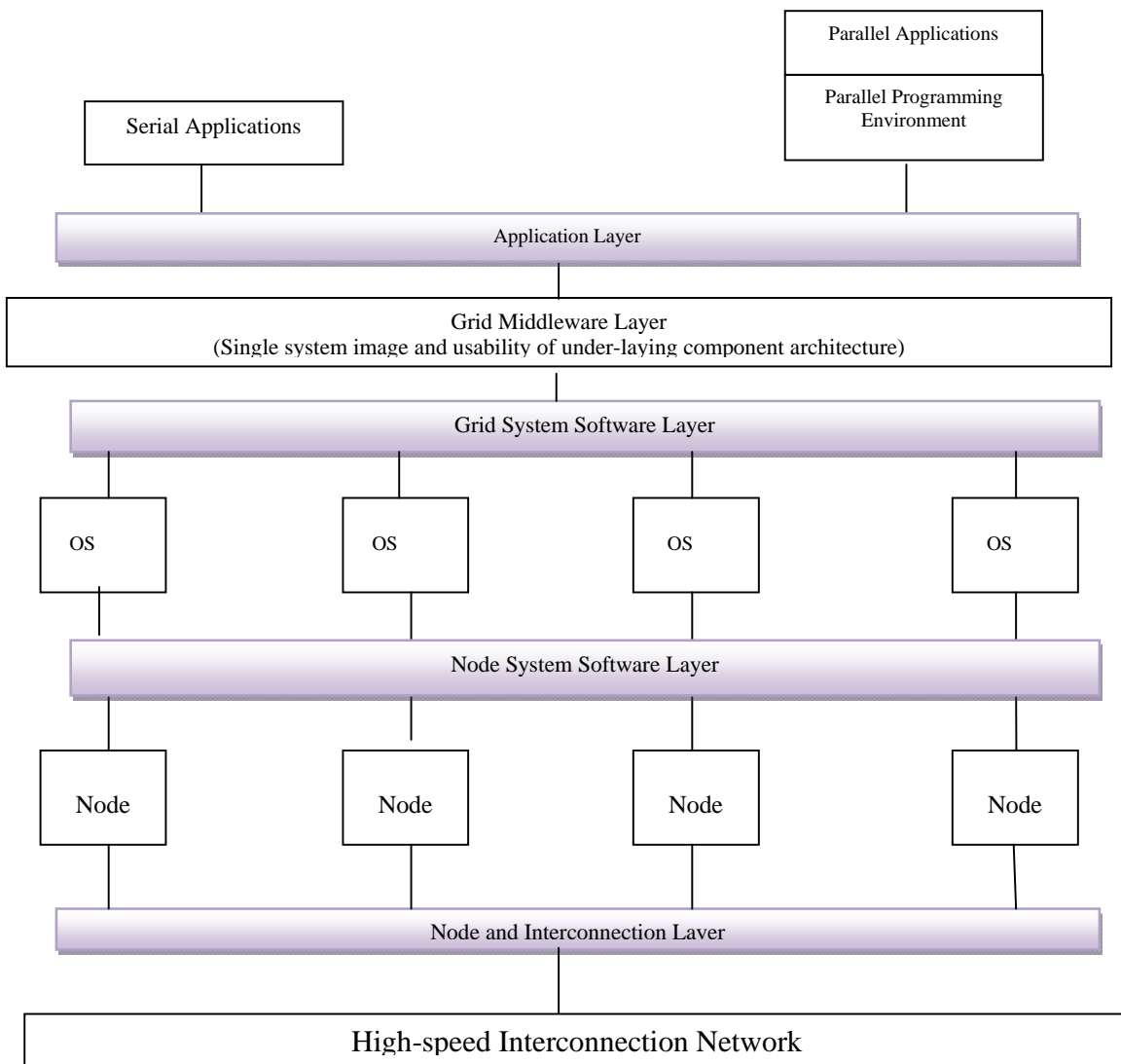


Fig.1 Four layer architecture of Grid Computing System

3. SECURITY REQUIREMENTS

The security requirement of the Grid Computing System described by I. Foster and other people [3] are as following:-

- Single sign-on
- Protection of credentials
- Interoperability with local security solutions
- Exportability
- Uniform credentials/certification infrastructure
- Support for secure group communication
- Support for multiple implementations

4. A GRID SECURITY POLICY

According to the security requirements, I. Foster and other people [3] presented security policy of Grid Computing System. The security policies are as follow-

- The Grid environment consists of multiple trust domains.
- Operations that are confined to a single trust domain are subject to local security policy only.
- Both global and local subject exist. For each trust domain, there exists a partial mapping from global to local subjects.
- Operations between entities located in different trust domains require mutual authentication.
- An authenticated global subject mapped into a local subject is assumed to be equivalent to being locally authenticated as that local subject.
- All access control decisions are made locally on the basis of the local subject.
- A program or process is allowed to act on behalf of a user and be delegated a subset of the user's rights.

- Processes running on behalf of the same subject within the same trust domain may share a single set of credentials.

4. FIVE LAYER SECURITY ARCHITECTURE OF GRID COMPUTING SYSTEM

Considering security requirement, security management of Grid Computing System and four layer architecture. We present new five layer security architecture from bottom to up these five layers are-

5.1 Node and Interconnection layer:-

This layer provides physical security to hardware resources.

5.2 System and network security layer:-

This layer includes virtual private network layer, secure socket layer, secure shell, firewalls, and integrity checks.

5.3 Security abstract layer:-

This layer encapsulates security technologies and provides uniform interface for Grid security protocol layer.

5.4 Grid security protocol layer:-

This layer provides Grid Security protocols like user proxy creation, resource allocation from process & mapping registration protocol.

5.5 Security application layer:-

This layer provides applications based on security protocols. The layers of the five layer security architecture and the layers of the four layer security architecture Grid Computing System corresponding relationships. We place node and interconnection layer and system and network security technology layer in different layer and place all system and network security technology in is same layer. Security abstract layer and security application layer are implemented in Grid system software layer of four layer architecture of Grid Computing System. The five layer security architecture layer supports services for higher layer and higher layer utilizes the services supported by lower layer.

I. Foster and other people [3] have been studying Grid security protocols these are given below-

- I. User proxy creation protocol
- II. Resource allocation protocol
- III. Resource allocation from process protocol
- IV. Mapping registration protocol

5. NEW SET OF SECURITY POLICY FOR FIVE LAYER SECURITY ARCHITECTURE

Considering the five layer security architecture of Grid Computing System now we will define a new set of security policy.

6.1 **Policy about Object:** - An object is a resource or process that is being protected by security policy. There are two kind of object in Grid Computing System:

- (a) Global Object &
- (b) Local Object

A Global Object is the abstraction of one or more local objects. Global Object and Local Object exist in Grid Computing System at the same time.

6.2 **Policy about Subject:** - A subject is a participant in a security operation. In grid system, a subject is generally a user, a process operating on behalf of a user, a resource, or process acting on behalf of a resource. There are two kind of subject in Grid Computing System:

- (a) Global Subject &
- (b) Local Subject

A Global Subject is the abstraction of one or more Local Subject. Global Subject and Local Subject exist in Grid Computing System at the same time.

6.3 **Policy about Security:** - There are two kinds of Security Policy in Grid Computing System :

- (a) Global Security Policy &
- (b) Local Security Policy

Global Security Policy is the abstraction of all Local Security Policy. Global Security Policy & Local Security Policy exist in Grid Computing System at the same time.

6.4 **Policy about Trust Domain:** - A Trust domain is a logical, administrative structure within which a single, consistent local security policy holds. In other words a trust domain is a collection of both subjects and objects governed by single administration and single security policy.

There are two types of trust domain – Global trust domain and Local trust domain. Global trust domain is the abstraction of all local trust domains. Global trust domain and Local trust domain exists in Grid Computing System at the same time.

6. CONCLUSION

Security problems in Grid Computing System are crucial because Grid Computing System works between Virtual Organizations (Heterogeneous Environment). Research on security is burning topic in Grid Computing System. We present five layer security architecture of Grid Computing System. Considering the Five layer security architecture based on Security Policy, we define a new set of Security Policy & present the representation. Considering the existing Grid Security Policy, we will extended authentication & authorization model of distributed System & define Grid Security Policy layer to solve the problems of authentication & authorization in multiple domain.

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