Overlay Networks

1. Architectural Description based Overlay Networks
2. Multiple Overlay Networks

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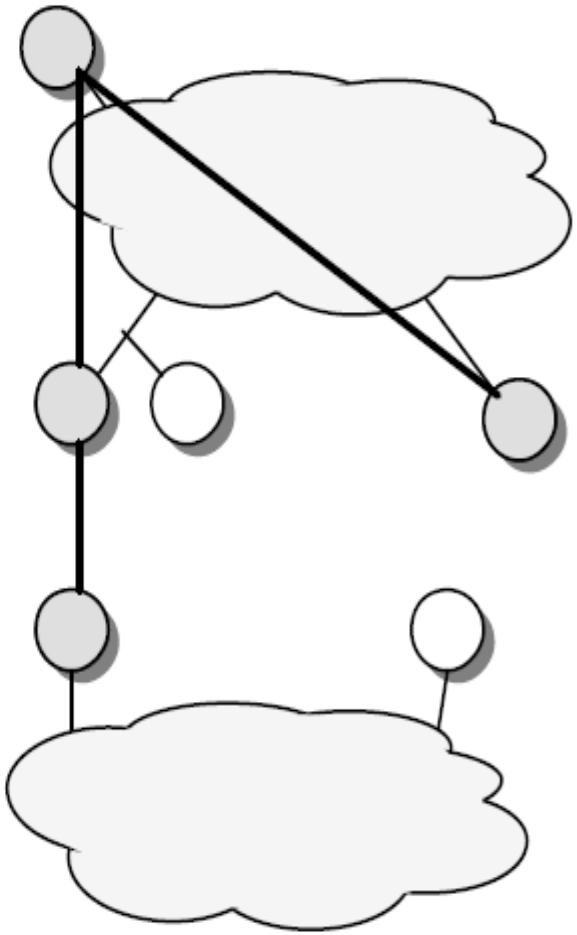
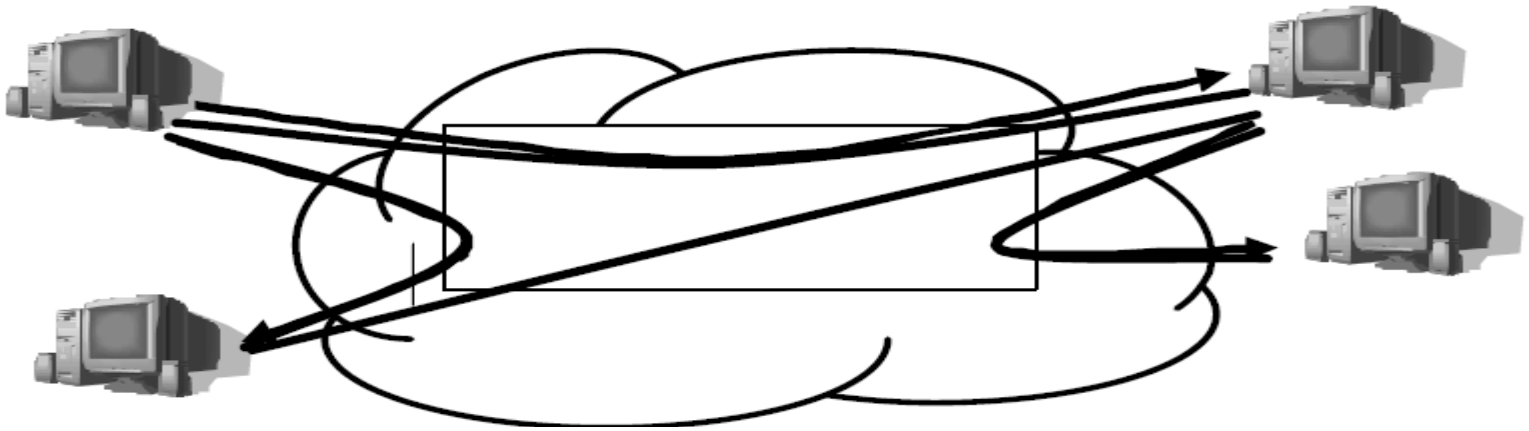
Definitions

- Network
  - defines addressing, routing, and service model for communication between hosts
- Overlay network
  - A network built on top of one or more existing networks
  - adds an additional layer of indirection/virtualization
  - changes properties in one or more areas of underlying network
- Alternative
  - change an existing network layer



Overlay Network

- An overlay network is a virtual network of nodes and logical links that is built on top of an existing network with the purpose to implement a network service that is not available in the existing network.



- **The Internet is an overlay network**
  - goal: connect local area networks
  - built on local area networks (e.g., Ethernet), phone lines
  - add an Internet Protocol header to all packets

Applications of overlay network

- Routing
- Addressing
- Security
- Multicast
- Mobility

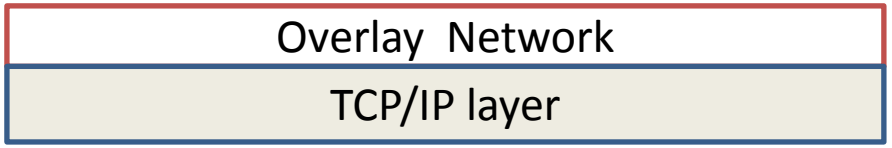
Architectural Description based Overlay Networks

- Abstract

- Heavily used in Distributed computing applications.
- Heterogeneous architectures
- A try to abstract architecture of an overlay n/w into a document called an ‘Architectural Description’ (AD)
- Contain Roles and Relationships of a particular Overlay n/w
- May be exchanged among nodes and parsed by nodes themselves enabling nodes to adopt different Roles and Relationships

- Dynamic formation of Overlay n/w
- Allows heterogeneous networks to work collaboratively, maintaining Security
- Allows multiple overlays
- Allows same set of nodes to switch between heterogeneous overlays at different time intervals.

Introduction



Architecture of an Overlay n/w is fixed.
However memberships and roles played by the nodes can be changed dynamically.

Actual overlay application run on top of the deployed overlay n/w

As a result tight coupling between Overlay application and overlay n/w.
We try to decouple these two by introducing an Architectural Description.
Creates Meta-layer between them

- Faciliating n/w :

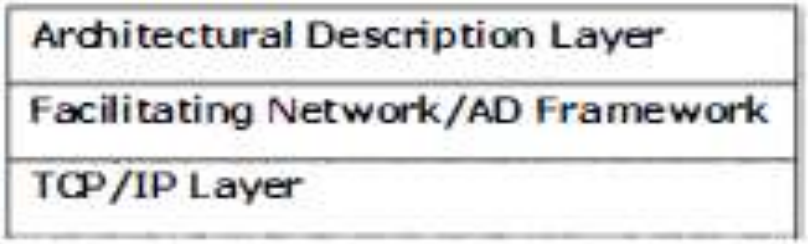


Fig. 2: Layers of AD based Overlay Networks

When AD documents pass through nodes, each node would adopt Roles and Relationships defined in AD.
Enables node to create their own 'Security roles'

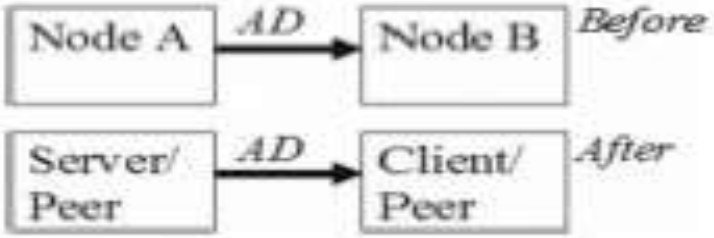


Fig. 1: Exchange and Execution of Architectural Descriptions

- By using AD documents and Role based approach, each node would be able to play multiple roles and adopt relative relationships.
- This improves dynamic behavior of Overlays, as AD documents are exchanged and executed dynamically.
- Hence AD based architecture facilitates creating new overlay architectures.
- By ‘injecting’ a new AD through the node, existing overlay may be erased.
- Alternatively may be superimposed or overlapped on an existing Overlay.

AD Framework

A. Architectural Description

- Tries to abstract the Overlay n/w architecture to an XML document.
- In this abstraction we try to identify the roles and relationships in a particular architecture.
- Ex: Client Server Network, Peer to peer n/w
- In addition to roles & relationships AD would contain parameters such as ‘Override’, ‘onFailure’.
- Security tags contains the security settings for a particular AD, such as encryption type, algorithm, key size.

Following is a template of a typical Architectural Description.

```
<architecturalDescription>
<id>001</id> - General Details
<roles>
<role></role> - Role Details --
<roles>
<relationships> - Relationship Details
<relationship></relationship>
<relationships>
<security></security> Security Details
</architecturalDescription>
```

B. Design

AD framework would enable the formation of the overlay n/w on top of the Facilitating n/w. It should sit in parallel with Facilitating n/w to exchange and execute AD documents.

Fig. 3: Design of the Framework

Features and applications

1. Integrating Heterogeneous Overlays
2. Super-impose Multiple Overlays
3. Switching between Heterogeneous Overlays
4. Enabling Overlays with Heterogeneous Security settings to collaborate
5. Key Exchange & key Management

Future work

- The prototype system needs to be extended to an actual distributed implementation. Which would make it possible to identify any practical issues.
- Current AD documents are concise and do carry only essential details. To make the full use of the AD based approach, AD documents need to have more details about architecture of overlay n/w.

- In the future implementation the routing information also be embedded in the AD document itself. This would allow the overlay n/w to dynamically change routing algorithm, adding more flexibility.
- ‘Security role’ can be further expanded so that networks having different security settings can inter-operate. This would allow n/w with heterogeneous security settings to work collaboratively.

Conclusion

- AD based overlay n/w is a novel concept in implementing overlay n/w. it tries to abstract architecture of an overlay n/w into ‘Architectural Description’ document.
- By exchanging the AD documents and ‘Executing’ them; each node in n/w may play different roles allowing dynamically change the Overlay n/w architecture.
- This also allows heterogeneous Overlays to work collaboratively.

- Allows n/w with heterogeneous security settings to work collaboratively , enabling nodes to play different ‘Security Roles’.
- Mean time AD documents serves as a means of Security Key Exchange as soon as a node is added to an Overlay n/w.