

Introduction

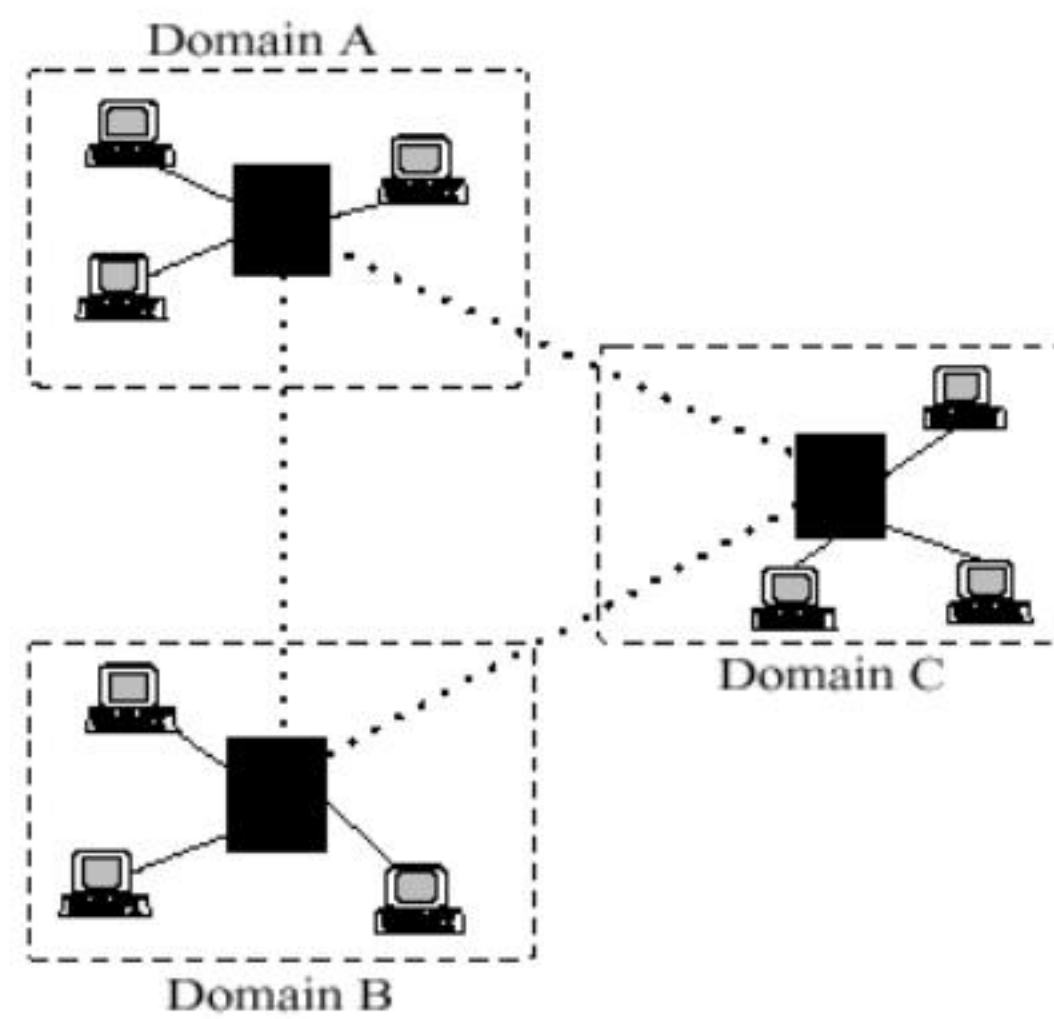
- **Dynamic coalitions** are formed when a number of security domains agree to share resources to achieve a common goal
- The operations of the coalition may also create new resources, which will be shared among the members
- The coalition members need to agree on a common **access control policy** for all shared resources
- The policy must be decided through **negotiation**, usually during coalition formation
- We use **game theory** to study the dynamics of this negotiation

Game Theory

- Tools for mathematical modeling of **conflict behavior** between **rational intelligent agents**
- Offers two kinds of approaches:
 - **Solution concepts** - what is likely to happen in a given situation?
 - **Mechanism design** - how to set up rules so that a certain thing happens?
- We focus on **cooperative game theory** - individuals are allowed to collude and form alliances

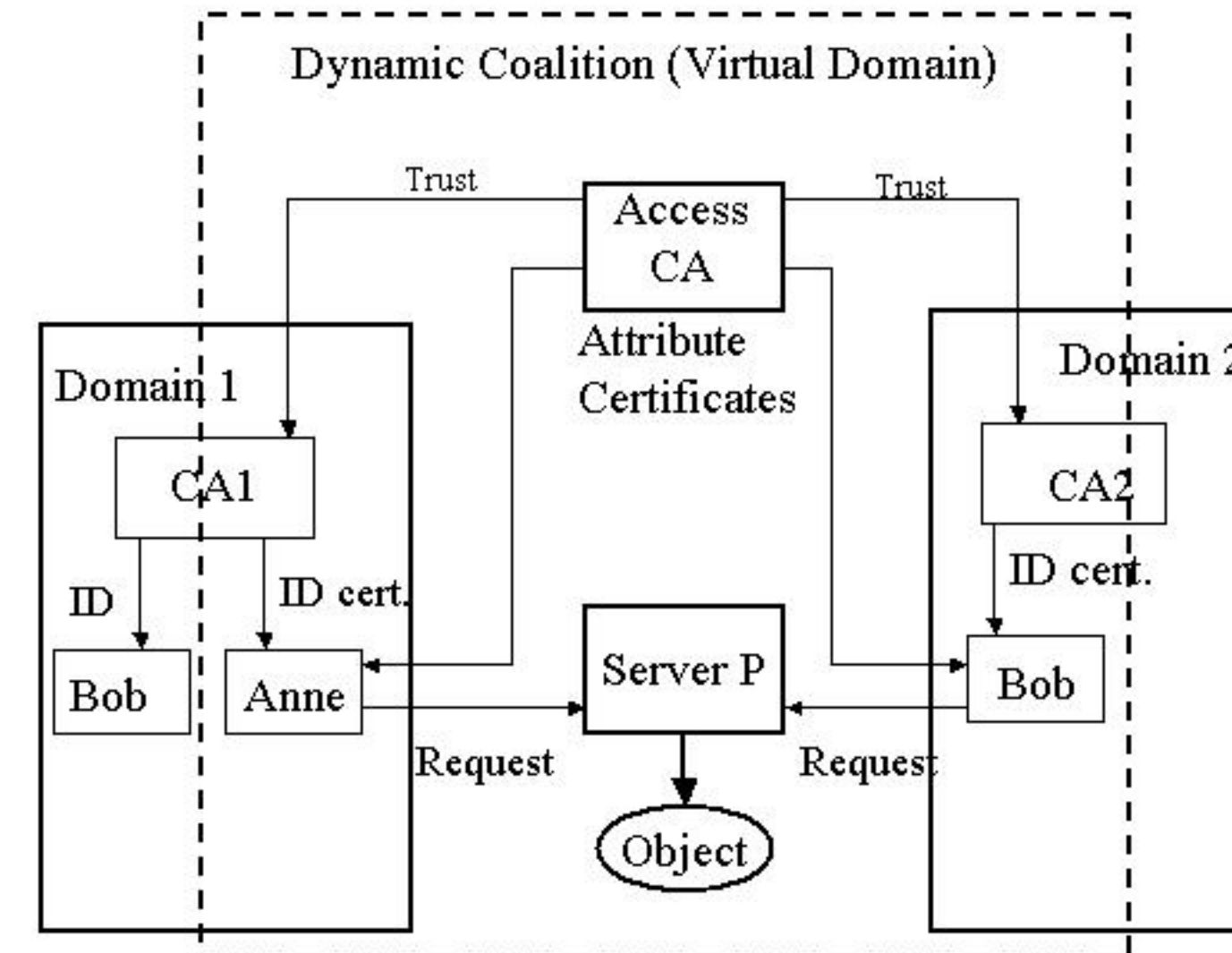
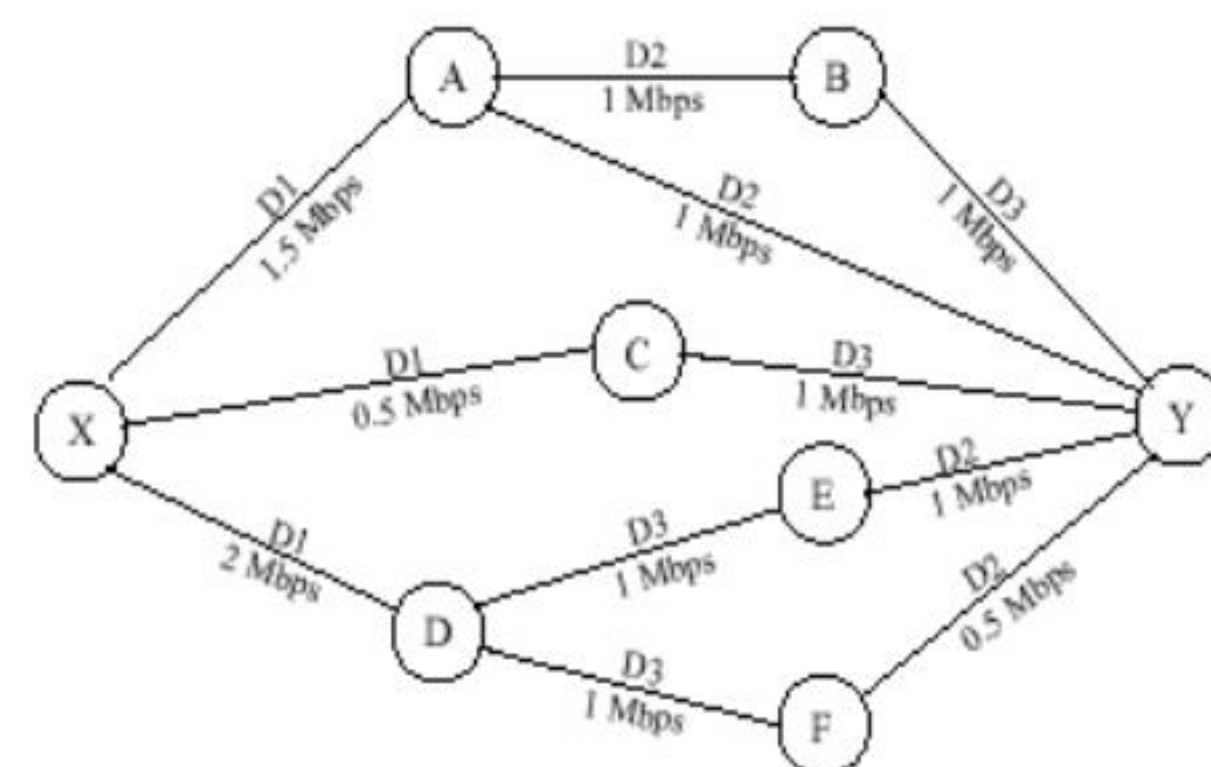
Solution Concepts

- Nucleolus:
 - “Fair” outcome - minimizes dissatisfaction of most dissatisfied participant
- Shapley Value
 - Measure of “bargaining power” - measures the average contribution (hence importance) of individuals to an alliance



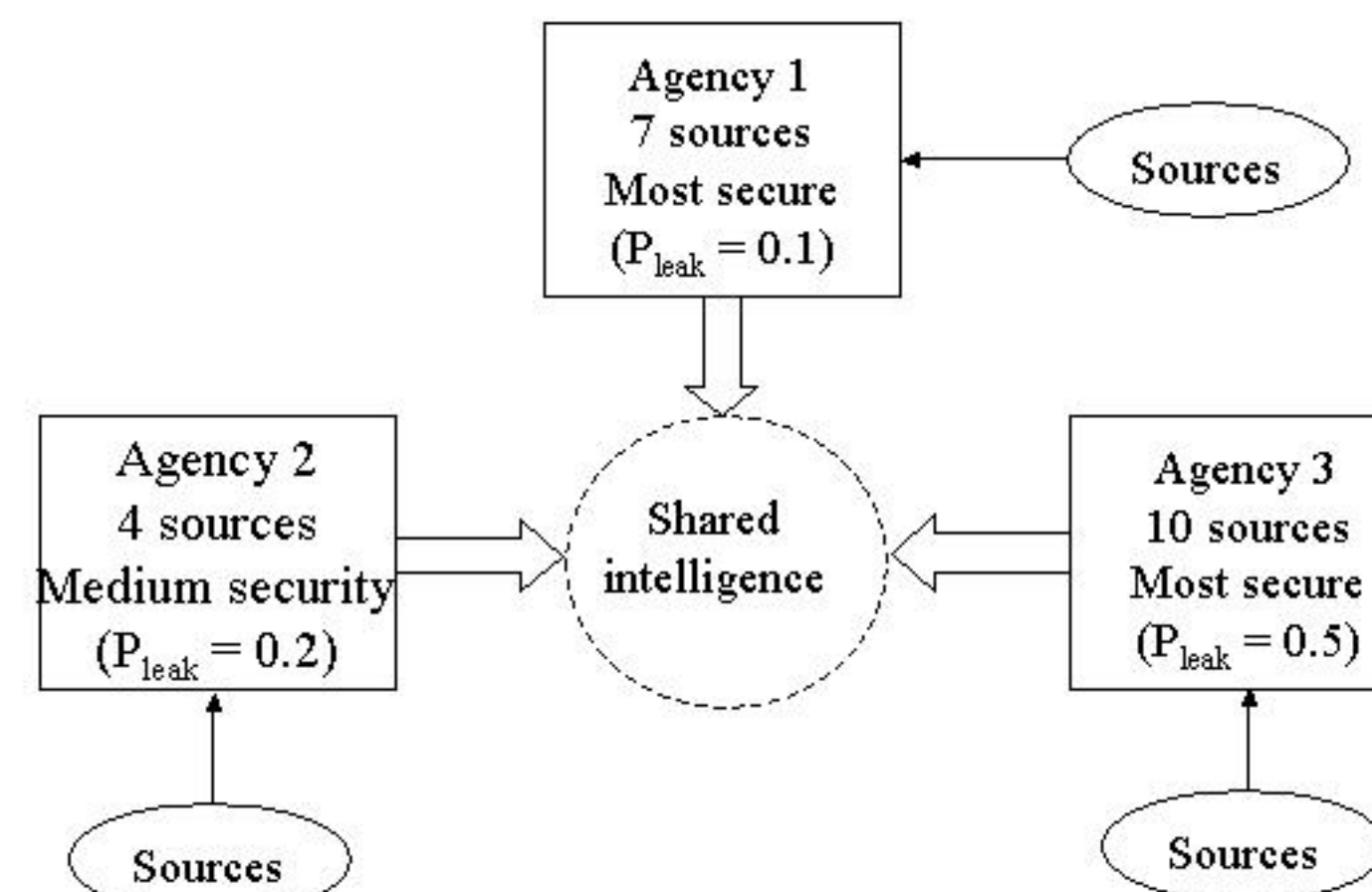
Example 1: Bandwidth Sharing

- Three domains D1, D2, D3 sharing bandwidth between X and Y
- Nucleolus:
 - All domains share equally; each gets 1.17 Mbps
- Shapley Value
 - D1: 1.42 Mbps, D2: 1.17 Mbps, D3: 0.92 Mbps



Example 2: Intelligence Sharing

- Three agencies A1, A2, A3 sharing intelligence sources. Compromise renders a source useless.
- Nucleolus:
 - A1 shares 2, A2 shares 4, A3 shares 10
- Shapley Value:
 - In this case, the minimum number of uncompromised sources an agency must receive to make participation worthwhile.
 - A1: 9.69, A2: 6.09, A3: 6.72.



Negotiating Access Control

- An access control policy consists of
 - A **policy model**, and a **policy model interpretation**
 - » **Access Authorization**, **Access Attribute** and **Access Management** properties
 - An **access control state** for the system satisfying the policy model
 - » Assignment of access privileges to various principals
- In practice, the state is often implemented through **certificate authorities** that issue attribute certificates to principals based on identity certificates in their own domains
- We focus on negotiating the access control state
- Currently working within the framework of Role Based Access Control
- Initial implementation uses a centralized negotiation server to collect proposals from members and commit final state

Future Work

- Develop a state transition model of access control negotiation and the associated optimization problem
- Apply game theoretic methods to above optimization problem
- Develop parsimonious negotiation protocols, i.e. protocols which do not require negotiators to unnecessarily divulge private information
- Integration of above protocol with a Role Based Access Control (RBAC) system