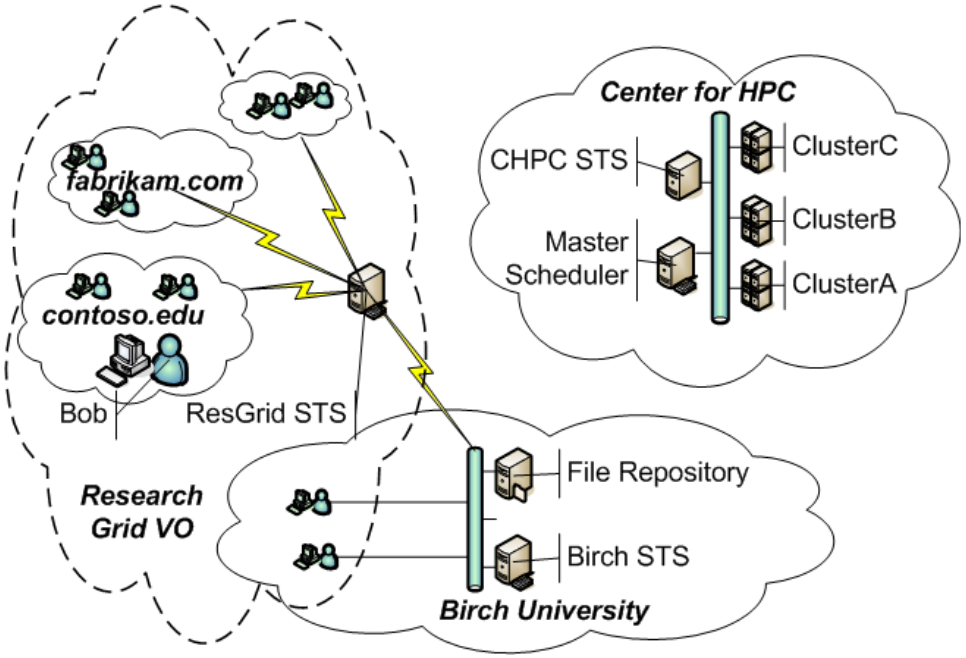
Authorization

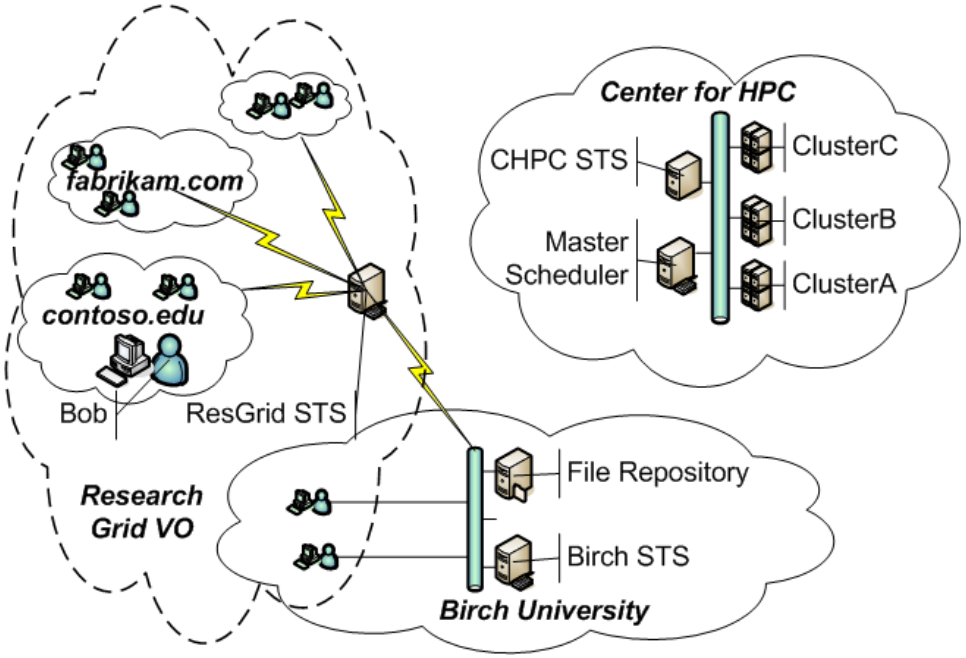
Security Policy Assertion Language

The Grid



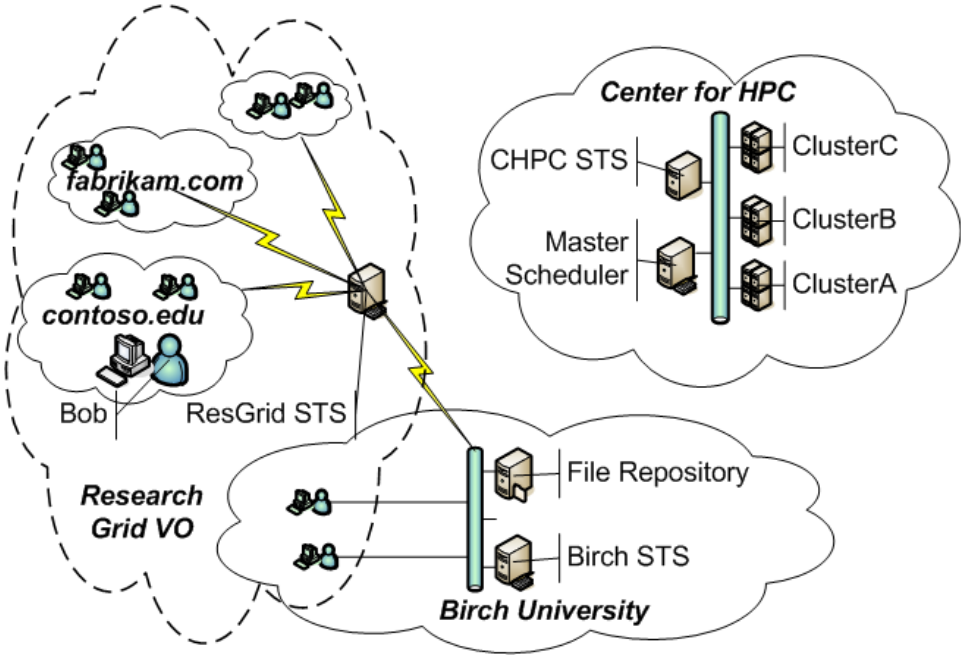
- Resources and user belong to a variety of different independent organizations
- Resources and users are connected via communication networks
- A virtual organization (VO) is a set of independent collaborating (real) organizations who establish a trust relationship for the purpose of sharing resources and skills to achieve a common objective

The Problems



- users are identified by their (local) organization and are unknown to other organizations in the VO
- resources are controlled by policies defined by their controlling organizations
- a user may want to combine the use of resources from different organizations for which the user has been separately authorized

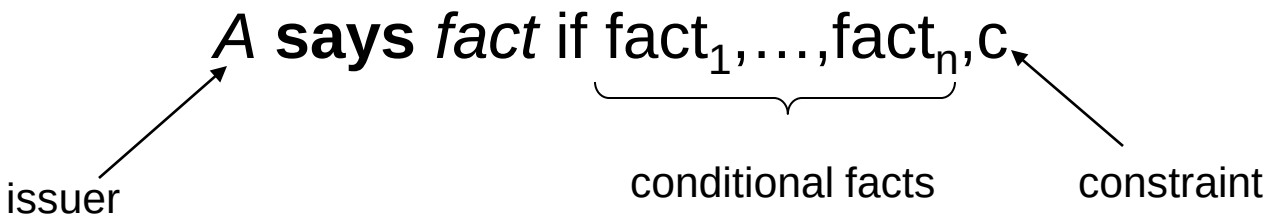
The Goals



- Describe explicit trust relationships
- Express security token issuance policies
- Provide security tokens that contain identities, capabilities, and/or delegation policies
- Express resource authorization and delegation policies

Elements

- Security tokens - digitally signed statements relevant to the authorization process (e.g., identities, capabilities, delegations)
- Security Token Server (STS) – a server that issues security tokens on behalf of a security principal
- Security Principal –
  - an entity capable of issuing authoritative statements (may be a person, organization, or service)
  - identified by a cryptographic key (e.g. K-ResGrid is the public key for the principal ResGrid)
- Assertion – a statement that a security principal believes to be valid possibly depending on other facts and constraints



Types of Assertions

- Attribute
  - Expressing a binding between a principal and one or more attributes

    STS says Alice is a researcher
- Capability
  - Expressing the right of a principal to exercise one or more actions on a resource

    FileServer says Alice can read /project
- Delegation
  - Expressing the granting of a capability possessed by one principal to a second principal

    Alice says Cluster can read /project/data
    If currentTime() <= 07/09/2006
- Trust
  - Expressing the willingness of one principal to believe certain types of assertions made by a second principal

    Cluster says STS can say *x* is a researcher
    FileSys says Univ can say *x* can say *y* can read /project

Variables

- An assertion may contain variables (see previous examples).
- Variables
  - are strongly typed
  - can be unrestricted (bind to any concrete value of the correct type)
  - can be restricted to a subset of concrete values based on a specific pattern
- A phrase is “ground” when it has no variables
- Examples

Cluster says *x* can execute dbgrep if *x* is a researcher

FileServer says *x* can say *y* can read *file* if
x can read *dir*, *file* in *dir*, markedConfidential(*file*)=no

(The later is a constrained delegation rule)

Constraints, Flat

- Constraints
  - Equality and inequality
  - Path constraints (hierarchical resources like file systems)
  - Regular expressions (patterns)

- Flat
  - A fact is “flat” if it does not include “can say” and nested otherwise
  - “Bob can read *f*” is flat
  - “Charlie can say Bob can read *f*” is nested

Patterns

- The SecPAL prototype uses the pattern-matching symbols shown in the table

Pattern	Matches
^	beginning of line
$	end of line
.	any single character
[…]	any character in …
x-*y*	any character in the range *x* to *y*
x+	one or more occurrences of *x*
(*x*?)	character *x* if it occurs
\	escape
\w	single character in a-zA-Z0-9
character	itself

- Examples:

K-CHPC says K-ResGrid can say x possess rfc822Name=^[-_a-zA-Z0-9]+@[-_a-zA-Z0-9]+$

K-CHPC says K-Birch can say x possess serviceName=^http(s?):\w+\.birch\.edu/\w$

Deduction Rules

$$\text{(cond)}\ \frac{(A \text{ says } fact \text{ if } fact_1, ..., fact_k, c) \in AC \quad AC, D \models A \text{ says } fact_i\theta \text{ for all } i \in \{1..k\} \qquad \models c\theta \qquad vars(fact\theta) = \emptyset}{AC, D \models A \text{ says } fact\theta}$$

$$\text{(can say)}\ \frac{AC, \infty \models A \text{ says } B \text{ can say}_D \ fact \qquad AC, D \models B \text{ says } fact}{AC, \infty \models A \text{ says } fact}$$

$$\text{(can act as)}\ \frac{AC, D \models A \text{ says } B \text{ can act as } C \qquad AC, D \models A \text{ says } C \ verbphrase}{AC, D \models A \text{ says } B \ verbphrase}$$

- AC is the assertion context
- D is the delegation flag (0=no delegation, infinity is unbounded delegation)
- θ is a binding of variables to constants and variables
- *vars(f)* is the set of free variables in *f*

Using the deduction rules

Assertions:

STS says Alice is a researcher (1)

Cluster says STS can say x is a researcher (2)

Cluster says x can execute dbgrep if x is a researcher (3)

Proof of "Cluster says Alice can execute dbgrep":

Cluster says STS can say x is a researcher (2)

STS says Alice is a researcher (1)

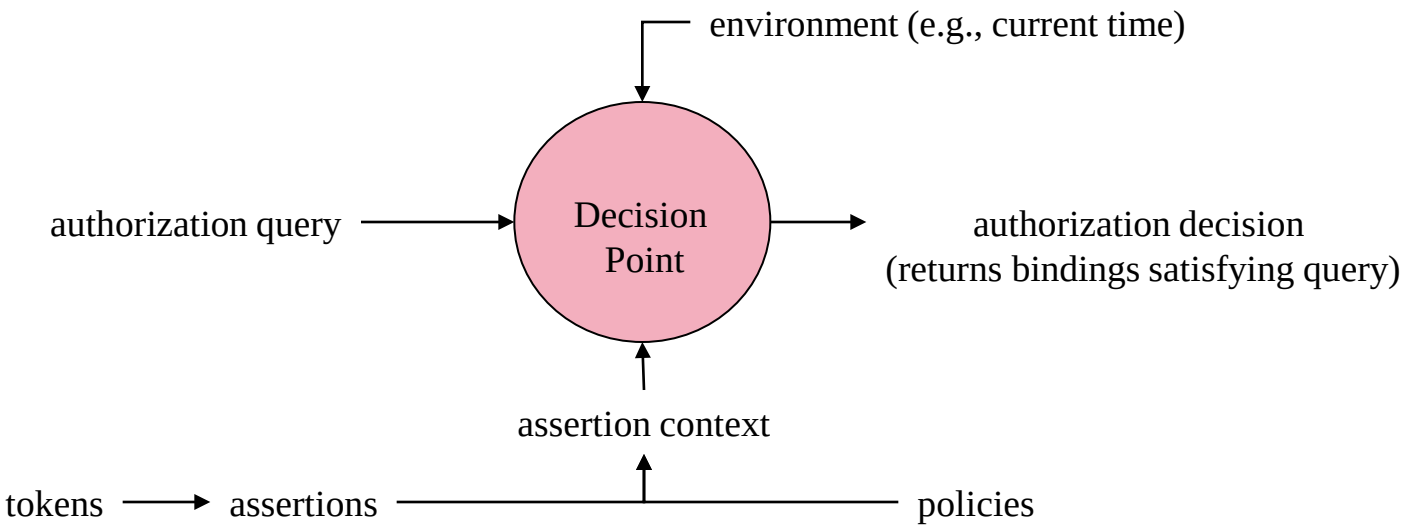
Cluster says Alice is a researcher (can say)(4)

Cluster says x can execute dbgrep if x is a researcher (3)

Cluster says Alice is a researcher (4)

Cluster says Alice can execute dbgrep (cond) (5)

Authorization Queries



- Authorization query:
  K-ResGrid says *x* possess rfc822Name=*e*
- Authorization decision:
  K-ResGrid says K-Bob posess rfc822Name=bob@contoso.edu

Authorization Query Table

- Provided by a local assertion context
- Maps parameterized operation names to predefined queries
- Resource guard invokes parameterized operation
- Example (containing deny-overrides):

```
check-access-permission(x):
  FileServer says x has access from t1 till t2
    t1 <= currentTime() <= t2,
  not exists t3,t4 (
    FileServer says x has no access from t3 till t4,
      t3 <= currentTime() <= t4)
```

Policy Idioms

- Mandatory Access Control (MAC)

  FileServer **says** *x* can read *f* if

  x is a user, *f* is a file, level(x) >= level(f)

  FileServer **says** *x* can write *f* if

  x is a user, *f* is a file, level(x) <= level(f)

- Roles

  NHS **says** FoundationTrainee can read /docs/

  NHS **says** SpecialistTrainee can act as FoundationTrainee

  NHS **says** SeniorMD can act as SpecialistTrainee

  NHS **says** Alice can act as SeniorMD

Policy Idioms

- Attribute-based delegation: assigns permissions based on attributes rather than identity
- Example:

Shop **says** *x* is entitled to discount if

x is a student till *date*,
currentTime() <= *date*, currentDay() = Friday

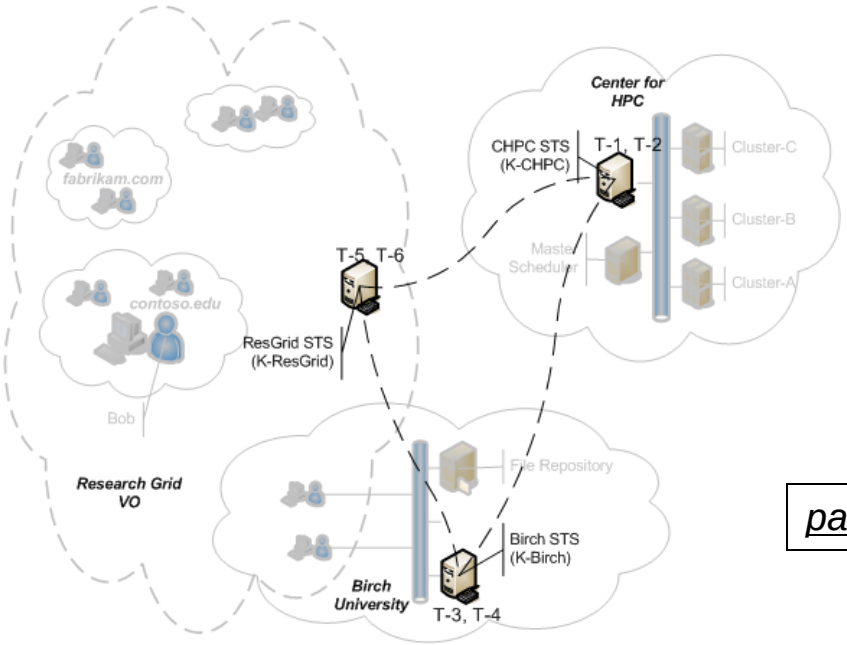
Shop **says** *univ* **can say** *x* is a student till date if

univ is a university,

Shop **says** *CommonwealthOfVirginia* **can say**

univ is a university

Federated Trust

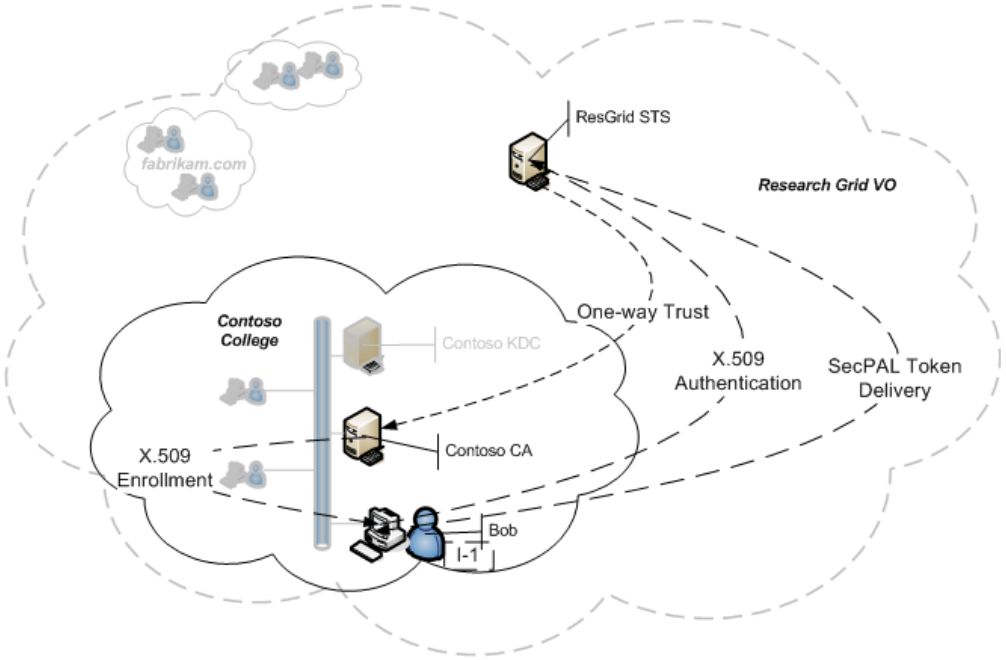


pattern denotes a pattern

Trust Policies

T-1: K-CHPC says K-ResGrid can say *x* possess rfc822Name=*name*, groupName=ResGrid/*group*
T-2: K-CHPC says K-Birch can say x possess serviceName=http(s?)://*server*.birch.edu/*service*
T-3: K-Birch says K-ResGrid can say *x* possess rfc822Name=*name*, groupName=ResGrid/*group*
T-4: K-Birch says K-CHPC can say x possess appName=*app*,dnsName=*name*.chpc.com
T-5: K-ResGrid says K-Birch can say *x* possess serviceName=http(s?)://*service*.birch.edu
T-6: K-ResGrid says K-CHPC can say *x* possess serviceName=http(s?)://*server*.c-hpc.com/*service*

Identity Token Acquisition



Steps

1. Bob receives X.509 identity certificate from Contoso CA
2. ResGrid trusts Contoso CA to issue X.509 identity certificates
3. Bob passes certificate to ResGrid STS
4. ResGrid STS issues SecPAL token

Assertions

ResGrid STS trust policy: K-ResGrid says K-Contoso can say *x* possess rfc822Name=*name@contoso.edu*
ResGrid from X.509 cert.: K-Contoso says K-Bob possess rfc822Name=bob@contoso.edu
ResGrid evaluates/issues: K-ResGrid says K-Bob possess rfc822Name=bob@contoso.edu