CS530
Authorization - Policy

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Authorization

- Final goal of system security
  - determine whether to allow an operation
    - authentication
    - audit - so that you can change policy to keep the bad guys out
- Depends upon
  - *policy* - rules followed by the system
  - possibly *authentication*
    - policy can be based on identity
  - other characteristics - e.g., time of day, network threat condition, system load

The Role of Policy in Security Architecture

Policy - defines what is allowed and how the system and security mechanisms should act
(misconfiguration - policy does not reflect intent)

Enforced By

Mechanism - provides protection
interprets/evaluates policy
(firewalls, ID, access control, confidentiality, integrity)

Implemented As

Software - which must be implemented correctly and according to sound software engineering principles

Policy: Review - The Access Matrix

- Policy represented by an Access Matrix
  - also called Access Control Matrix
  - one row per object
  - one column per subject/principle
  - tabulates permissions
  - but implemented by:
    - *capability* list (like a key ring)
    - *Access Control List* (ACL)
      - recall that it's harder to determine who has access with ACL

Policy models: Bell-LaPadula

- *Discretionary* policy
  - based on Access Matrix - *owner* of an object can determine who has access
- *Mandatory* policy
  - owner of an object does not get to decide who has access
  - *Top Secret, Secret, Confidential, Unclassified*
  - ** property*: S can write O if and only if Level S ≤ Level O
    - *write UP*, *read DOWN*
      - it's possible that I can create a file that I cannot read
  - create categories so that some members in a class cannot see some documents
  - this approach tries to minimize the speed of secret leaks
- (more models in Bishop's book, e.g., integrity policy)

Role Based Access Control

- In a way, similar to groups in UNIX, but more general
  - in UNIX, an object can belong to only a single group, inconvenient to create dynamic groups
- Three phases
  - administration
  - session management
  - access checking
- Typical policies
  - object policies fairly static
  - user's roles can change
    - but no need to list all objects to which users has access
- Maps to typical organizational policies
  - can implement separation of roles

Security is More Than Mix of Point Solutions

- Today's security tools work with no coordinated policy
  - firewalls and Virtual Private Networks
  - authentication and Public Key Infrastructure
  - intrusion detection and limited response
- We need better coordination
  - intrusion response affected at firewalls, VPN's and applications
  - not just who can access what, but policy says what kind of encryption to use, when to notify ID systems
- Tools should implement coordinated policies
  - policies originate from multiple sources
  - policies should adapt to dynamic threat conditions
  - policies should adapt to dynamic policy changes triggered by activities like September 11th response

Policies Originate from Multiple Sources

- Discretionary policies associated with objects
  - read from existing applications or extended ACLs
    - e.g., one module for reading .ssh files and one module for reading .htaccess files
- Local system policies merged with object policies
  - broadening or narrowing allowed access - can ignore discretionary policy
    - e.g., deny all web accesses from certain domains
- Policies imported from policy/state issuers
  - example of policy issuers is virus checker from Network Associates or Symantec
  - example of state issuers is HIPAA - healthcare related policy for healthcare providers
  - (cont...)

Policies Originate from Multiple Sources (Cont...)

- Policies imported from policy/state issuers (cont...)
  - ID system issues state credentials
  - these credentials may embed policy as well
- Policies embedded in credentials
  - these policies attach to user/process credentials and apply to access by only specific processes
    - e.g., extra audit required from outsiders
  - this also allows chaining
- Policies evaluated remotely
  - credential issuers (e.g. authentication and authorization servers) evaluate policies to decide which credentials to issue.

Policies Origins Summary

- HIPAA, other legislation
  - e.g., access to student records
- Privacy statements
  - need to know how it is actually enforced
- Discretionary policies
- Mandatory policies (e.g. classification)
- Business policies

GAA-API: Integration through Authorization

- GAA: Generic Authorization and Access-control
- Focus integration efforts on authorization and the management of policies used in the authorization decision
  - not really new - this is a reference monitor (as in TOPS-20 and MULTICS)
  - applications shouldn't care about authentication or identity
    - separate policy from mechanism
  - authorization may be easier to integrate with applications
  - hide the calls to individual security services
    - e.g., key management, authentication, encryption, audit
  - can perform adaptive audit
    - dynamic policy
    - when ID detects something, start collecting additional information or start requiring authentication even for internal users

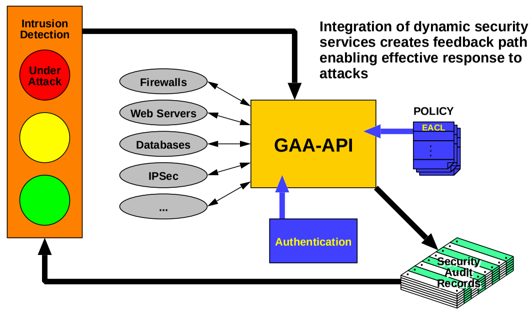
GAA-API

- Sometimes it is not possible to plug in security at low level
  - need information at the application level
    - Ex: SSL is in the lower layer, it cannot deal with user certificates
- GAA-API: application just asks *if something is allowed*
  - return value is either *yes*, *no*, or *maybe*
    - maybe means you need additional things, e.g., network source address must come from a certain domain (this information, again, may not be available at lower layers)
- Subject/principle is represented by a Security Context (SC)
  - why not an identify?
    - because sometimes it's not necessary, e.g., to access this, pay $5 (no authentication)

GAA-API (Cont...)

- EACL (extended ACL)
  - the language used by GAA
  - extended to include information such as:
    - time of day
    - network threat condition
    - system load

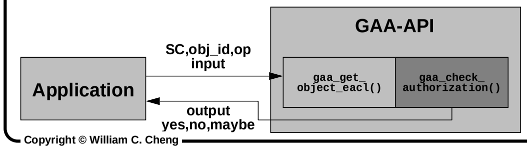
Authorization and Integrated Security Services



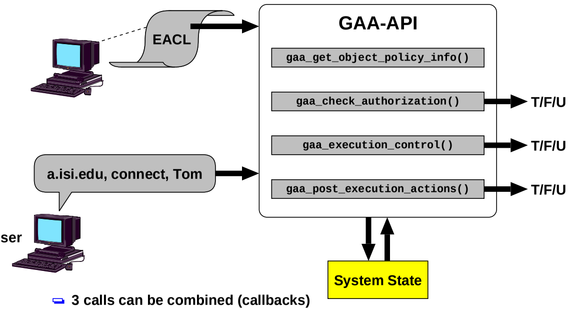
Integration of dynamic security services creates feedback path enabling effective response to attacks

Generic Authorization and Access-control API (GAA-API)

- Allows applications to use the security infrastructure to implement security policies
  - `gaa_get_object_policy_info()` function called before other GAA-API routines which require a handle to object EACL to identify EACLs on which to operate
    - can interpret existing policy databases
  - `gaa_check_authorization()` function tells application whether requested operation is authorized, or if additional application specific checks are required



Three Phases of Condition Evaluation



- 3 calls can be combined (callbacks)
- other example: payment system

Communicating threat conditions

- Threat conditions and new policies carried in signed certificates
  - added info in authentication credentials
  - threat condition credential signed by ID system
  - it is often done to run *System High* - always assumes that thread condition is RED, only change if received signed certificate to say that it’s no longer RED
- Base conditions require presentation or availability of credential
  - matching the condition brings in additional policy elements

Integrating Security Services

- The API calls must be made by applications
  - this is a major undertaking, but one which must be done no matter how one chooses to do authorization.
- These calls are at the control points in the applications
  - they occur at auditable events, and this is where records should be generated for ID systems
  - they occur at the places where one needs to consider dynamic network threat conditions
  - adaptive policies use such information from ID systems
  - they occur at the right point for billable events

Advances Needed in Policy

- Ability to merge & apply policies from many sources
  - legislated policies
  - organizational policies
  - agreed upon constraints
- Integration of policy evaluation with applications
  - so that policies can be uniformly enforced
- Support for adaptive policies is critical
  - allows response to attack or suspicion
- Policies must manage use of security services
  - what to encrypt, when to sign, what to audit
  - hide these details from the application developer

GAA - Applications and Other Integration

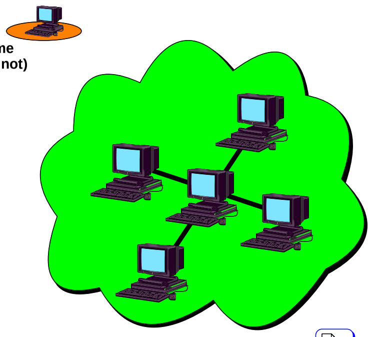
- Web servers - apache
- Grid services - globus
- Network control - IPsec and firewalls
- Remote login applications - ssh
- Trust management
  - can call BYU code to negotiate credentials
  - will eventually guide the negotiation steps

What Dynamic Policies Enable

- Dynamic policy evaluation enables response to attacks:
  - lockdown system (or bump up security) if attack is detected
  - stablish quarantines by changing policy to establish isolated virtual networks dynamically
  - allow increased access between coalition members as new coalitions are formed or membership changes to respond to unexpected events
    - e.g., homeland security
    - e.g., open things up - sharing is allowed only when certain credentials have been received

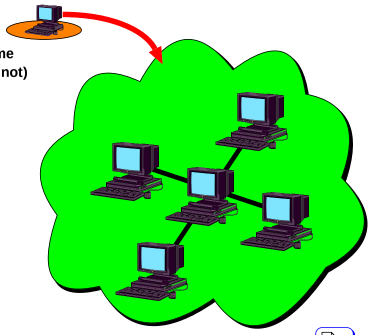
Demo Scenario - LockDown

- You have an isolated local area network with mixed access to web services (some clients authenticated, some not)



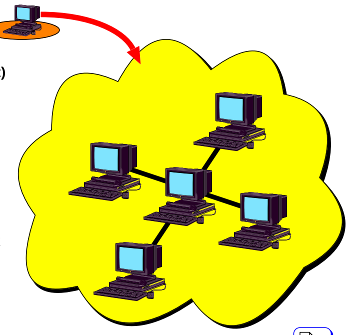
Demo Scenario - LockDown (Cont...)

- You have an isolated local area network with mixed access to web services (some clients authenticated, some not)
- You need to allow incoming authenticated SSH or IPSec connections



Demo Scenario - LockDown (Cont...)

- You have an isolated local area network with mixed access to web services (some clients authenticated, some not)
- You need to allow incoming authenticated SSH or IPSec connections
- When such connections are active, you want to lock down your servers and require stronger authentication and confidentiality protection on all accesses within the network



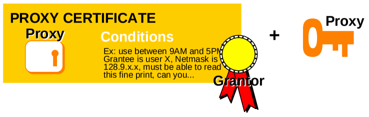
Demo Scenario - LockDown (Cont...)

- But how do you know if someone is connecting from the outside?
  - you need integrated solutions
- The scenario is like having a visitor in a classfied area
  - *security* can be *inconvenient*

Proxies

- A *proxy* allows a *second principal* to operate with the *rights and privileges* of the principal that issued the proxy
  - existing authentication credentials
  - too much privilege and too easily propagated
- Restricted proxies
  - by placing conditions on the use of proxies, they form the basis of a flexible authorization mechanism

Restricted Proxies


PROXY CERTIFICATE
Proxy
Conditions
Ex: use between 9AM and 5PM
Grantee is user X, Netmask is
128.9.x.x, must be able to read
this fine print, can you...
Grantor
+
Proxy

- Two kinds of proxies
  - proxy key needed to exercise *bearer proxy*
    - a bearer proxy can be used by anyone
  - restrictions limit use of a *delegate proxy*
- Restrictions limit authorized operations
  - individual objects
  - additional conditions
    - when, where, how
    - additional audit records may be produced

Proxies Example

- Ex: I want to print to this printer
  - printer only accepts authorization from authorization server
  - talk to authorization server
  - authorization server says "maybe" with condition in credential
  - since you are a visitor, you must pay
  - authorization server generates proxy, includes policy, returns to user as capability

Mechanisms Summary

- Access Matrix
  - Access Control List (ACL)
  - Capability list (key ring)
- Unix file system
  - basically ACL
  - at login, look up which groups you belong, associate that list with your login process (this is like capability)
  - when you open a file, the file descriptor is like capability(?)
- SSH authorized key files
- Restricted proxies, extended certificates
- Group membership
- Payment
- Web server
  - .htaccess

Summary

- Policies naturally originate in multiple places
  - future systems need to deal with this
- Deployment of secure systems requires coordination of policy across countermeasures
- Effective response requires support for dynamic policy evaluation
- Such policies can coordinated the collection of data used as input for subsequent attack analysis