.Net Security

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CSE681 – SW Modeling & Analysis
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References

- Developmentor Slides from MSDNAA, Keith Brown
- Introduction to Evidence-based Security in .Net Framework, Brad Merrill, http://www.dcl.hpi.uni-potsdam.de/LV/Components04/VL7/05a_Security-detailed.pdf
- Securing, Deploying and Maintaining .Net Applications, Patrick Tisseghem, www.u2u.net

Agenda

- Threats
- Windows Role-Based Security
- Code Access Security

Basic Security Issues

- Confidentiality
  - Disclose information only to authorized users
- Integrity
  - Ensure that data is not modified without authorization
- Availability
  - Decide who has access to information and how to make access effective
- Authentication
  - Identify a user securely
- Authorization
  - Define a set of allowed actions for authorized users
- Non repudiation
  - Log users, their actions, and the objects used.

Security Models

- Windows and .Net
  - Role-based
    - Authenticate and authorize users, groups, and accounts (System, Local service, Network service)
    - Actions are authorized through permissions
  - Evidence-based or Code Access Security (CAS)
    - Code is elevated to the security status of a user.
    - Authorization is based on evidence
      - url, zone, publisher, strong name, custom assembly attributes
    - Actions are authorized through policies

Win Security Definitions

- Definitions for ***people*** and ***groups*** of people
  - SID – Security IDentifier
    - Data structure used to identify user or group.
  - Access Token
    - A data structure that holds a SID for a security principal, the SIDs for each group the principal belongs to, and a list of the principal's priviledges on the local computer.
  - Principal
    - An account holder that is assigned a SID for access to resources, e.g., user, group, service, or computer.

Win Security Definitions

- Definitions for ***objects***
  - Files, directories, kernel objects
  - ACL – Access Control List
    - Set of permissions for a specific object or a set of the object's properties.
    - Discretionary (DACL) and System (SACL) are sub-groups.
  - Security Descriptor
    - A data structure holding information about a protected object, e.g., who can access, in what way, whether audited.

Win Security Definitions

- Combinations of ***people*** and ***objects***
  - Security Context
    - Set of rules for a user's actions on a protected object
    - Combination of user's access token and object's security descriptor
  - Security Policy
    - Rules that define the allowable contexts and mandatory groups.

Role-Based Security

- Use role-based security in programs to control access to methods or properties at run-time.
- Host authenticates user and provides identity and role information to CLR.
  - Uses NTFS access control lists, IIS security settings.
- CLR makes that information available to code via APIs and permission demands.
- Can isolate security from code using attributes defined in System.Security or EnterpriseServices
  - System.Security is limited to Windows user groups
  - EnterpriseServices uses COM+ roles
    - Classes have to inherit from EnterpriseServices
- Which to choose?
  - If application has both managed and unmanaged use COM+.
  - If application is entirely managed then System.Security is appropriate.

Code Access Security

- Goals
  - End-user experience
    - Managed apps just run
    - Safe defaults, no run-time decisions needed
  - Administrator
    - All settings in one place and easy to customize
    - Simple policy model
    - Security administration tools
      - .Net configuration, CASPOL
  - Developer
    - Focus on application, security comes free
    - Easy to understand and extend when needed

Mobil Code

- Old Model
  - Obtained from a network, often via a web page.
  - Without CAS have either full trust or no trust.
  - User decides whether to run.
  - If run, code has all the user's priviledges.
  - Inproc COM component, when loaded, becomes part of the process.
  - Can't distinguish between library code and original application code.
- CAS model
  - Operation based on evidence.
  - Allowed actions can be defined at very detailed level.
  - Each assembly can have its own security context.

Evidence-Based Security

- Definitions
  - Permissions
    - Objects that represent specific authorized actions
    - Permission grant is an authorization for an action given to an assembly
    - Permission demand is a security check for specific grants
  - Policy
    - Set of permissions granted to an assembly
  - Evidence
    - Inputs to policy about code
  - All three can be extended using security APIs.

Standard Permissions

- Permissions for framework resources
  - Data, environment, file IO, Message Queue, reflection, sockets
  - Directory services, event log, web, performance counters, registry, UI
  - DNS, file dialog, isolated storage, printing, security system

Standard Permissions

- Identity permissions
  - Publisher, site, string name, url, zone
- User identity permission
  - Only non-code access permission in Framework.

Code Access Security

- Is evidence-based
- Most permissions are code access
  - Demanding permission performs a stack walk checking for grants of all callers
  - Two ways to make checks
    - Imperative – call a method
    - Declarative
      - Attributes in code
      - Attributes in configuration file
  - Get security by
    - Calling class libraries in Framework
    - Calling application code with checks

How it works

- Loader extracts evidence from assembly
- Evidence is input to policy
  - Each level, Enterprise, Machine, User, and AppDomain, are evaluated
    - For each level the union of grants for each matching code group is determined
    - Intersection of permissions from each of these levels are granted to the assembly
- Apply any assembly permission requests
- Result is the permissions granted to the assembly.

Stack Walk Modifiers

- Assertions
  - If code vouches for its callers then checks for permissions stop here.
- Gatekeeper classes
  - Managed wrappers for unmanaged resources
    - Demand permission to call unmanaged
    - Assert permission to call unmanaged
    - Make the call to unmanaged

Code Access Control

- Identity permissions can apply to code as well as users and groups
  - Based on evidence – signature, location, …
- Declarative checks made by JIT at compile-time.
- Imperative checks made by CLR at run-time.

Policy

- Process of determining what permissions to grant to code.
  - Per-assembly basis
- Policy levels
  - Enterprise
  - Machine
  - User
  - Application domain
- Each policy level is a collection of code groups
  - All code, internet zone, intranet zone, site, strong name (MS Office), publisher
- Permission grants are intersection of policy levels and union of collection of code groups.
  - Code gets only permissions common to Enterprise, Machine, user, AppDomain
  - Gets all permissions of all groups to which it belongs.

Default Policies

- Local Computer
  - Unrestricted
- Intranet
  - Limited read environment, UI, isolated storage, assertion, web access to same site, file read to same UNC directory
- Internet
  - Safe UI, isolated storage, web access to same site
- Restricted
  - No access, can’t execute
- Strong name (Framework classes)
  - Unrestricted

Framework Support

- Classes used to represent evidence
  - Zone, Url, Site, ApplicationDirectory, StrongName, Publisher, Hash
- Classes used to represent permissions
  - DBDataPermission, PrintingPermission, SocketPermission, FileIOPermission, RegistryPermission, …

.Net Configuration Tool

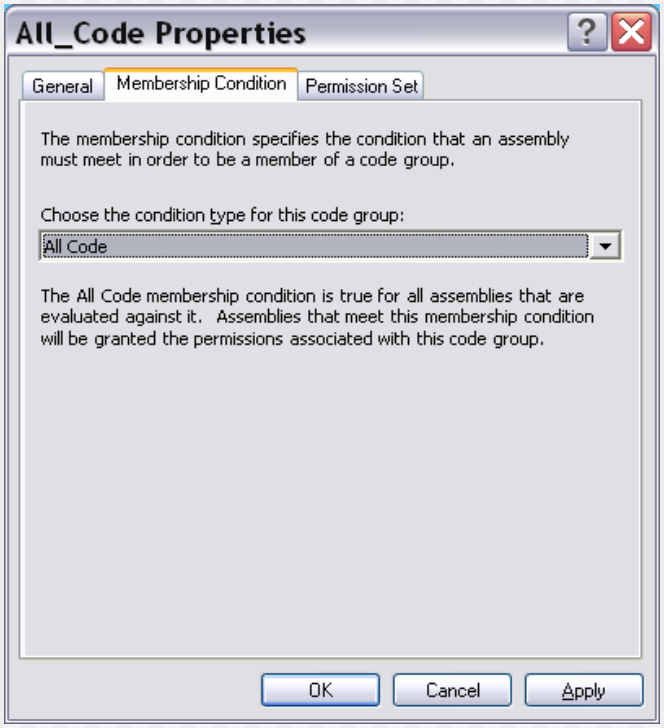
.NET Configuration 1.1

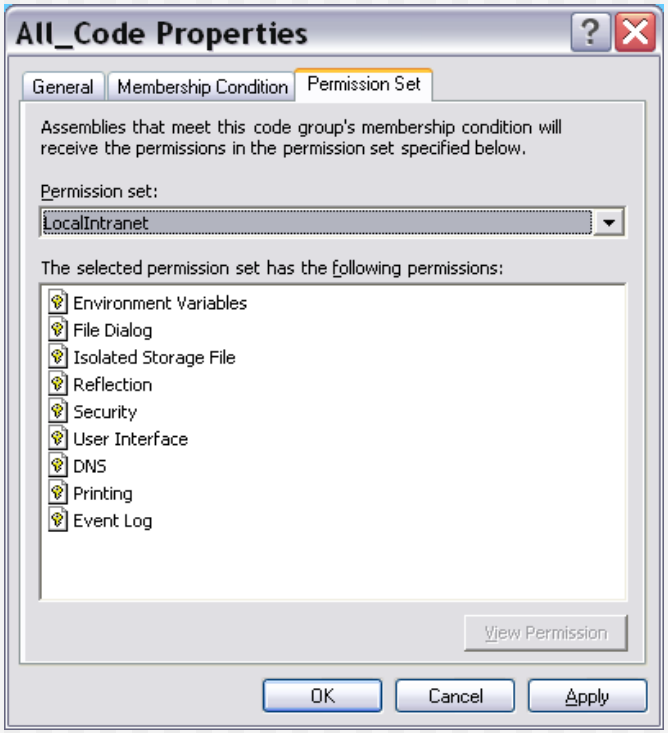
File Action View Help

- My Computer
  - Assembly Cache
  - Configured Assemblies
  - Remoting Services
  - Runtime Security Policy
    - Enterprise
      - Code Groups
      - Permission Sets
      - Policy Assemblies
    - Machine
      - Code Groups
      - Permission Sets
      - Policy Assemblies
    - User
      - Code Groups
        - All_Code
      - Permission Sets
        - FullTrust
        - SkipVerification
        - Execution
        - Nothing
        - LocalIntranet
        - Internet
        - Everything
      - Policy Assemblies
  - Applications

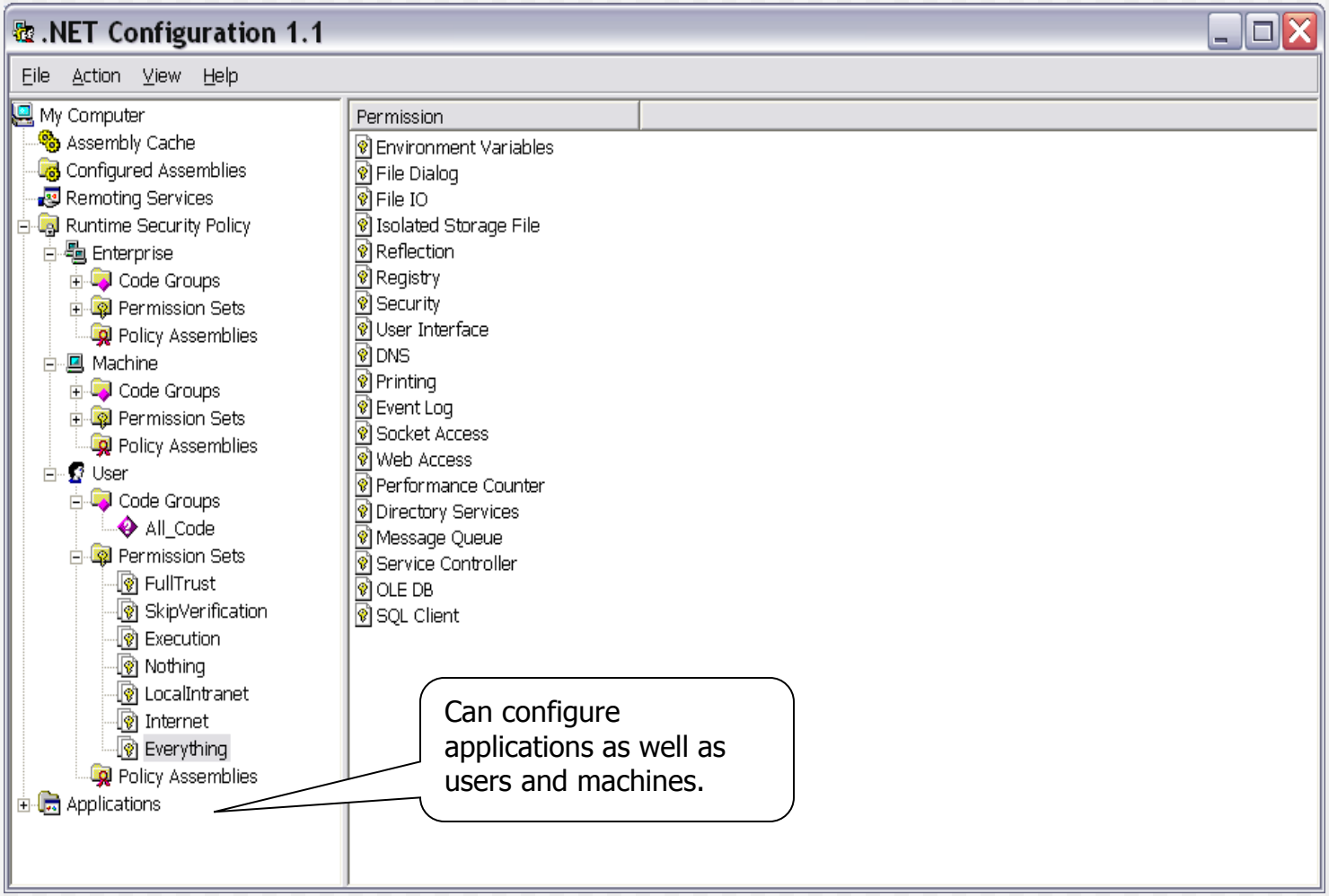
Assembly Name	Public Key Token	Version
mscorlib.resources	b77a5c561934e089	
System	b77a5c561934e089	1.0.5000.0
System.resources	b77a5c561934e089	1.0.5000.0
System.Data	b77a5c561934e089	1.0.5000.0
System.Data.resources	b77a5c561934e089	1.0.5000.0
System.Drawing	b03f5f7f11d50a3a	1.0.5000.0
System.Drawing.resources	b03f5f7f11d50a3a	1.0.5000.0
System.Messaging	b03f5f7f11d50a3a	1.0.5000.0
System.Messaging.resources	b03f5f7f11d50a3a	1.0.5000.0
System.ServiceProcess	b03f5f7f11d50a3a	1.0.5000.0
System.ServiceProcess.resources	b03f5f7f11d50a3a	1.0.5000.0
System.DirectoryServices	b03f5f7f11d50a3a	1.0.5000.0
System.DirectoryServices.resources	b03f5f7f11d50a3a	1.0.5000.0

Editing Permissions

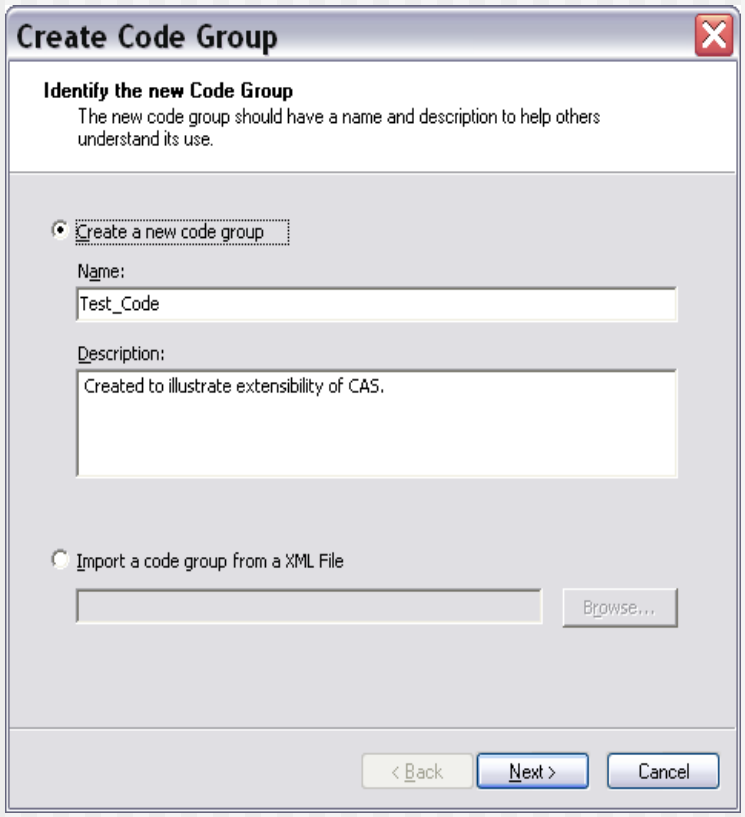


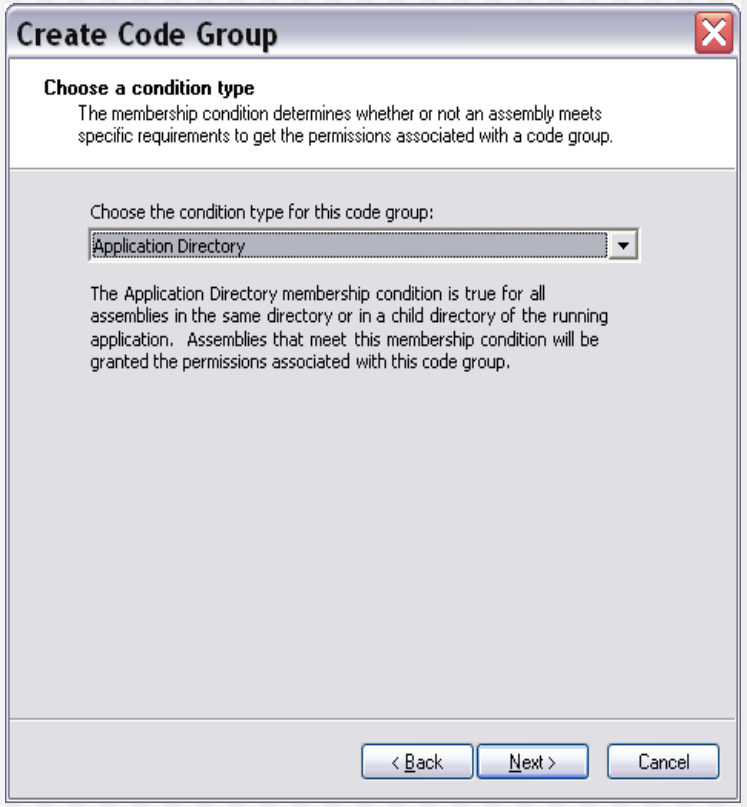


All Standard Permissions

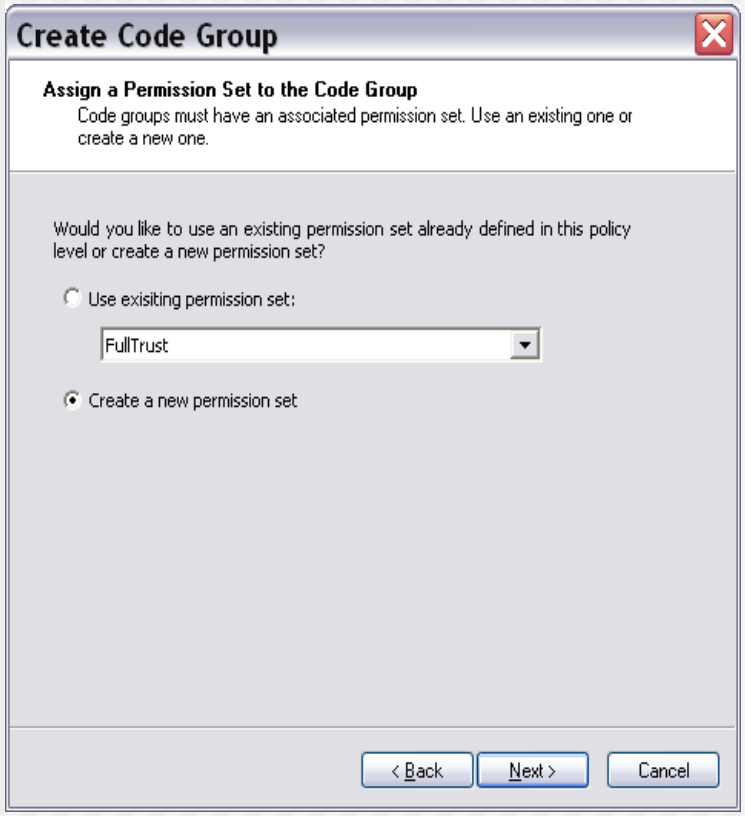


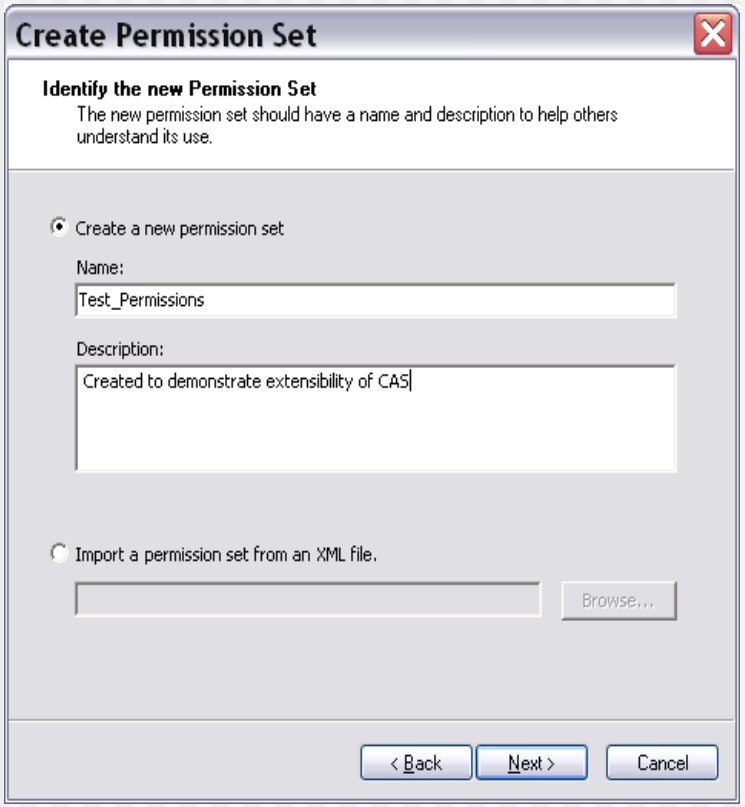
Creating a User Code Group



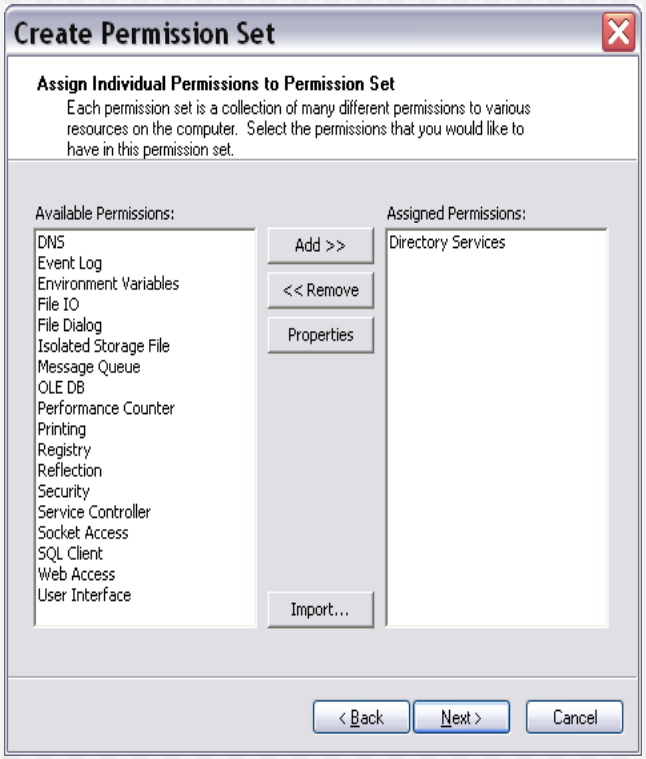


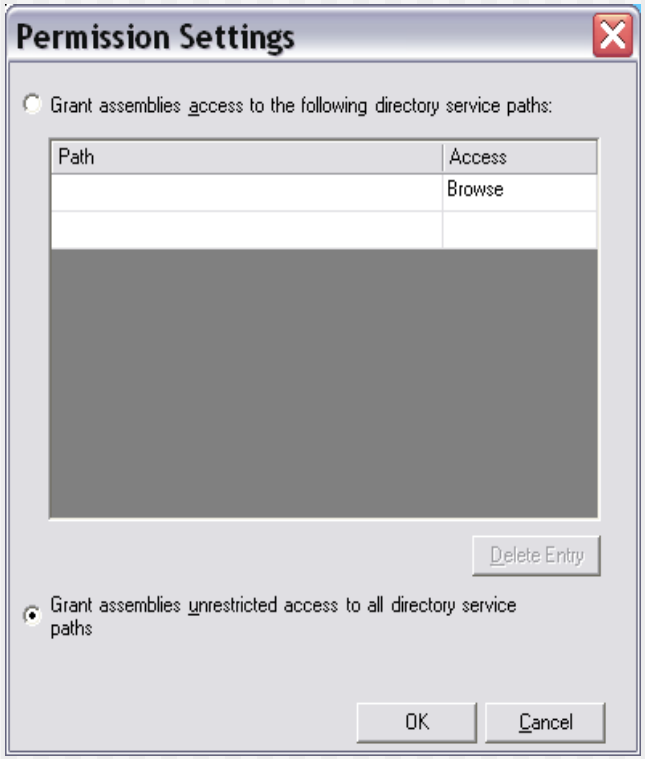
Adding New Permissions



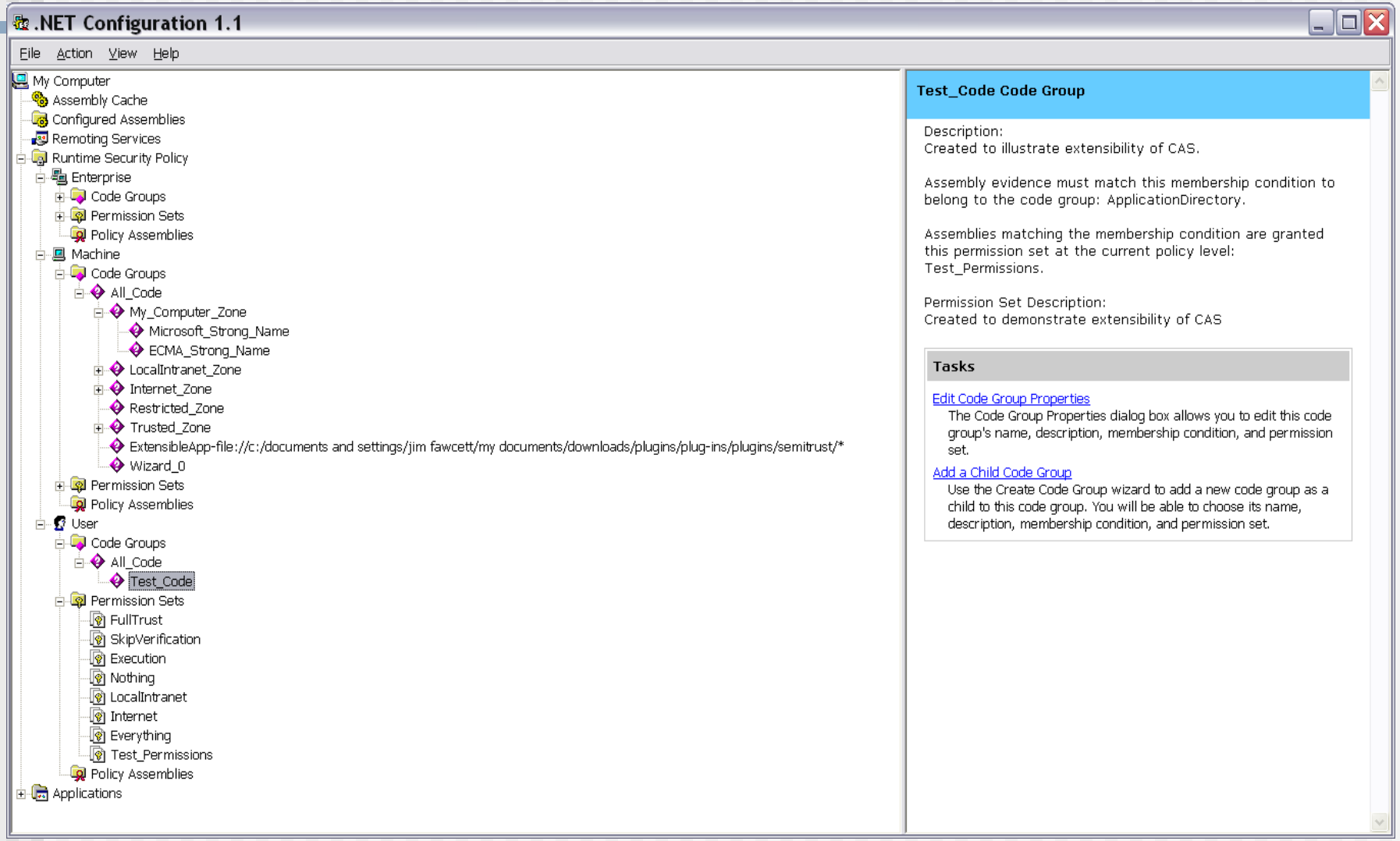


Specific Permissions





The Result


.NET Configuration 1.1
File Action View Help
My Computer
Assembly Cache
Configured Assemblies
Remoting Services
Runtime Security Policy
Enterprise
Code Groups
Permission Sets
Policy Assemblies
Machine
Code Groups
All_Code
My_Computer_Zone
Microsoft_Strong_Name
ECMA_Strong_Name
LocalIntranet_Zone
Internet_Zone
Restricted_Zone
Trusted_Zone
ExtensibleApp-file://c:/documents and settings/jim fawcett/my documents/downloads/plugins/plug-ins/plugins/semitrust/*
Wizard_0
Permission Sets
Policy Assemblies
User
Code Groups
All_Code
Test_Code
Permission Sets
FullTrust
SkipVerification
Execution
Nothing
LocalIntranet
Internet
Everything
Test_Permissions
Policy Assemblies
Applications
Test_Code Code Group
Description:
Created to illustrate extensibility of CAS.
Assembly evidence must match this membership condition to belong to the code group: ApplicationDirectory.
Assemblies matching the membership condition are granted this permission set at the current policy level: Test_Permissions.
Permission Set Description:
Created to demonstrate extensibility of CAS
Tasks
Edit Code Group Properties
The Code Group Properties dialog box allows you to edit this code group's name, description, membership condition, and permission set.
Add a Child Code Group
Use the Create Code Group wizard to add a new code group as a child to this code group. You will be able to choose its name, description, membership condition, and permission set.

Evidence

- Evidence is input to policy
  - Strong name, publisher identity, location
- Evidence is extensible
  - Any object can become evidence
  - Only affects permission grants if some code group condition uses it
- Hosts
  - Machine, IIS, ASP.Net, SQL Server
- Fully trusted hosts specify implicitly trusted evidence.
- Semi-trusted hosts cannot provide evidence.
- Hosts can limit policy for AppDomains they create.

Requesting Permissions

- Assemblies can request permissions
  - Minimal, Optional, Refused
  - If policy does not grant everything in Minimal set, assembly will not load.
  - Assembly is granted:
    MaxAllowed ∩ (Minimal ∪ Optional) – Refused
  - Example:

```
[assembly:UIPermissionAttribute
  (SecurityAction.RequestMinimum,
   Window=UIPermissionWindow.SafeSubWindows)
]

[assembly:SecurityPermissionAttribute
  (SecurityAction.RequestRefused,
   UnmanagedCode=true)
]
```

Minimizing Security Flaws

- Safe code
  - Managed code verified for typesafety at runtime.
  - Eliminates:
    - Buffer overrun attacks
    - Reading private state or uninitialized memory
    - Access to arbitrary memory in process
    - Transfer execution to arbitrary location in process
- Developers can use Least Priviledge.
- Code access security blocks most luring attacks.
  - Stack walks prevent malicious code from using otherwise secure code obtained from naïve user.

Summary

- Managed code has both Role-based and Evidence-based (CAS) security applied.
  - Get a lot for free, simply by loggin in and running code that calls Framework Library.
  - You can add security features to your code as well.
- CAS is .Net model for mobile code.
- Evidence is discovered by loader
- Policy turns evidence into permissions
- Permissions determine what your code can and cannot do.