The State of Component Software

Summer 2000

COM+ Base Services

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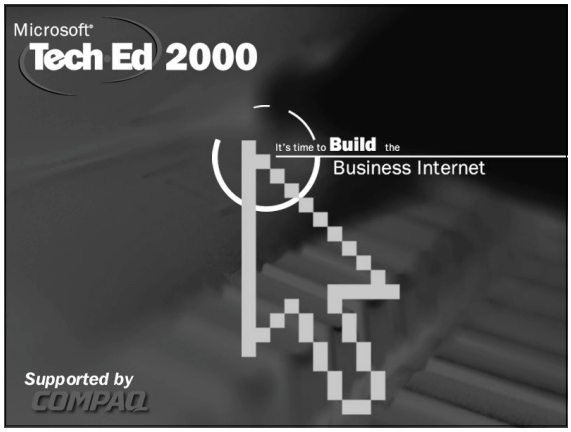

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components defined

Software components are binary units of independent production, acquisition and deployment that interact to form a functioning system

Clemens Szyperski, 1997
Component Software: Beyond Object-Oriented Programming, Addison Wesley

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components in nature

- Independent deployment implies dynamic linking
- Dynamic linking fairly widespread by late 1980's/early 1990's
- DLL acts as atomic unit of deployment
  - Molecules also possible…
- "Component-based" applications formed from these atoms

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components 1988: property bag o' code

- Early DLLs were largely raw executable code with symbol tables
  - Table of imported symbols -> DLL name
  - Table of exported symbols -> offsets

flib.dll

Export Table

Symbol	RVA
f	0x1024

Code

```
push ebp
mov esp, ebp
push [esp]
call iat[0]
```

Import Table

Library	Symbol
hlib.dll	h

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components 1993: code + type info

mlib.dll

Type Library

TypeName	Definition
Person	`Dog x; long y`
Dog	`float a; float b;`

Export Table

Symbol	RVA
Work(Person)	0x1024
Eat(Dog)	0x1326

Code

```
push
mov
push
call
```

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from com to com+

- COM introduced type into loader
  - Units of code loaded based on concrete class, not filename
  - Entry point resolution/fixups performed based on typed object references, not flat symbol names
  - Calling convention expanded to encompass typed parameter lists, not numeric frame sizes

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from com to com+

- COM+ makes the type system of the loader extensible
  - Concrete classes are adorned with annotations that augment the type definition
  - COM+ loader examines these annotations and augments the new object accordingly
  - Very similar to mix-in style of development

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com+ attributes

- Concrete classes are adorned with attributes
  - Attributes indicate requirements of class code
  - Attributes indicate extended services
  - Attributes are examined at instantiation-time by the loader
  - Loader augments new object based on attributes of target class

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attributes as mixin

```
class MyClass : TransactionalObject,
                SynchronizedObject,
                PoolableObject,
                java.lang.Serializable
{
  void hello();
};
```

```
[
  Transaction(Required), Synchronized(Required),
  Poolable(true), Serializable(true)
]
class MyClass {
  void hello();
};
```

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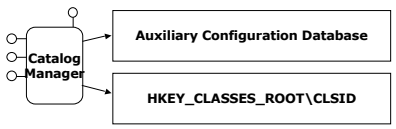
attributes and the catalog

- Attributes are logically associated with class code by the catalog manager
  - Manages storage/caching of attribute values
  - Keeps HKEY_CLASSES_ROOT in sync
  - Exposed via scriptable, remotable COM interfaces
  - Exposed via Component Services Explorer



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com+ applications

- COM+ groups configured classes into applications
  - Each configured class belongs to exactly one application
  - A single DLL may have classes in multiple applications
  - Applications act as a unit of deployment/management
  - Application attributes are shared by all classes in application

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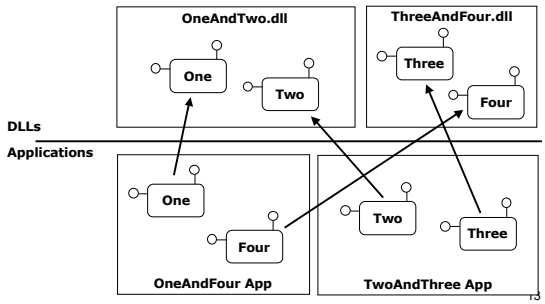
com+ applications



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you and your attributes

- Attributes influence object activation and method execution
  - Attributes often influence semantics of implementation code
  - Explicit programming in configured class often necessary
  - Attributes may require you to implement private interfaces
  - Attributes may augment your class with interfaces you have never seen before

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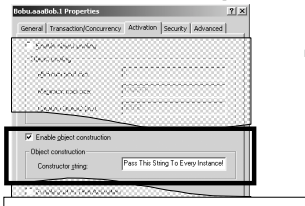
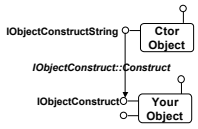
attribute example






```
interface IObjectConstruct : IUnknown {
  HRESULT Construct([in] IDispatch* pClassInit);
}
```

```
interface IObjectConstructString : IDispatch {
 [propget]
 HRESULT ConstructString([out, retval] BSTR* s);
}
```

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attribute inventory: applications

Activation Type	Library (inproc)/Server (surrogate)
Authentication Level	None, Connect, Call, Packet, Integrity, Privacy
Impersonation Level	Identify, Impersonate, Delegate
Authorization Checks	Application Only/Application + Component
Security Identity	Interactive User/Hardcoded User ID + PW
Process Shutdown	Never/N minutes after idle
Debugger	Command Line to Launch Debugger/Process
Enable Compensating Resource Managers	On/Off
Enable 3GB Support	On/Off
Queueing	Queued/Queued+Listener

Underlines indicate settings available under MTS

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attribute inventory: classes

Transaction	Non Supported, Supported, Required, Requires New	Class
Synchronization	Non Supported, Supported, Required, Requires New	Class
Object Pooling	On/Off, Max Instances, Min Instances, Timeout	Class
Declarative Construction	Arbitrary Class-specific String	Class
JIT Activation	On/Off	Class
Activation-time Load Balancing	On/Off	Class
Instrumentation Events	On/Off	Class
Declarative Authorization	Zero or more role names	Class Interface Method
Auto-Deactivate	On/Off	Method
Must Activate in Activator's Context	On/Off	Class

Underlines indicate settings available under MTS

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attributes as mixin revisited

- Attributes may need to augment instances of a class
  - May add extended properties to each instance
  - May add extended public methods to each instance
  - May require private methods of instance to work properly

```
class ColorAttribute : public IColorableObject {
private:
  virtual void OnColorChanged() = 0;
public:
  COLOR m_color;
  void colourMyWorld(COLOR c) {
    m_color = c; this->OnColorChanged();
  }
};
```

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attributes and context

- COM+ envelopes every object in a context
  - Each thread has a notion of the “current” context
  - System switches context to match target object of the “current” method
  - Exposed to your method code via CoGetObjectContext

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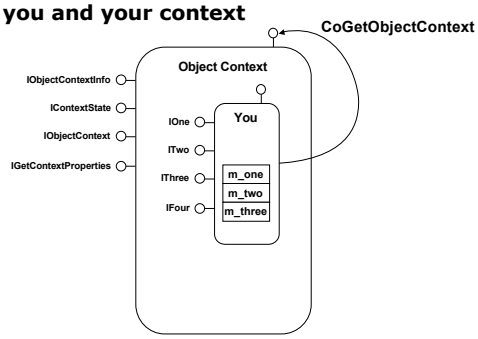
you and your context



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context as property bag

- A context is an ordered collection of named context properties
  - Each attribute can contribute context properties
  - Properties act as extended data members to target object
  - Properties are used by the plumbing that needs them

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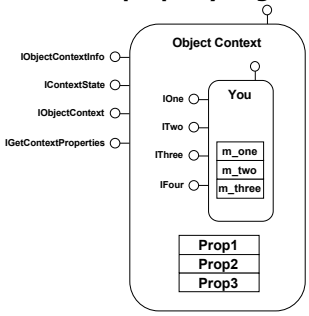
context as property bag



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context propagation

- Context properties can propagate at instantiation time
  - The target class’s attributes can see properties of the creator
  - Attributes can vote on whether a creator’s context is OK
    - The lack of an attribute is a yes vote
  - If new context is needed, each attribute can use the creator’s properties to initialize the properties in the new context

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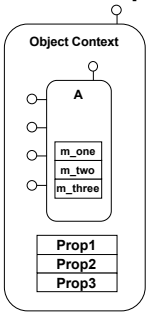
context propagation



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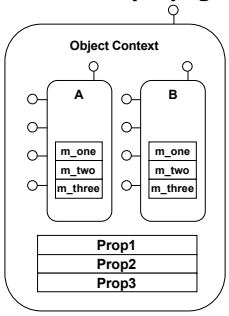
context propagation



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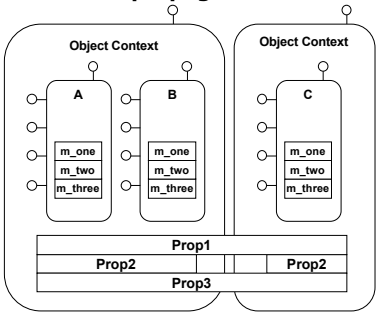
context propagation



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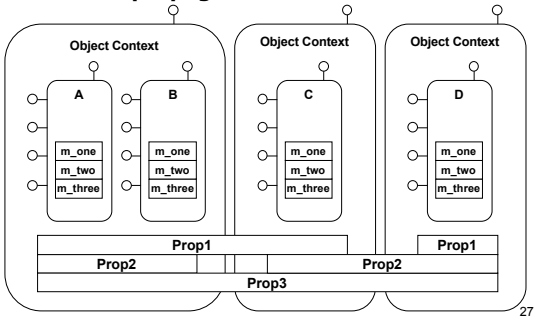
context propagation



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cross-context object references

- Proxies are used to allow references to appear in foreign contexts
  - Proxy implements all *remotable* interfaces of target object
  - Proxy may implement additional *local* interfaces
  - Proxy informs target context to invoke method on target object

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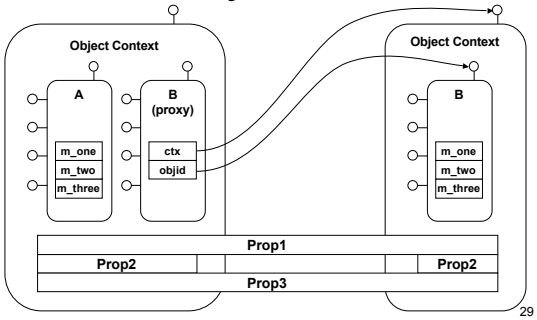
cross-context object references



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context relativity

- Object references are only valid in the context in which they were initialized
  - Cannot store raw object references in cross-context state
  - Proxies implicitly use system marshaling APIs to pass context-neutral cookies
  - You only need to use context-neutral cookies when bypassing method calls (e.g., global variable)

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you and your context revisited

- Configured classes typically require a new context
- Non-configured classes typically live in creator's context
- All COM objects are context-bound by default
- Non-configured classes can implement IMarshal customize marshaling behavior
  - Can marshal by value by serializing into cookie
  - Can aggregate the free-threaded marshaler to become context-agile

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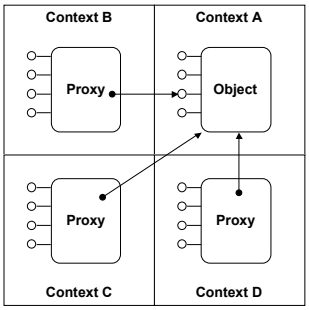
example: a context-bound object



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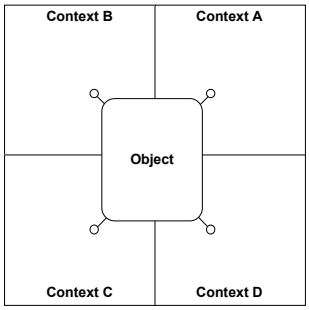
example: a context-agile object



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object pooling

- Classes can be configured to support object pooling
  - System maintains a per-process pool of instances
  - Instances are either in use or in inventory
  - Per-class high and low-watermarks for inventory + in use
  - Per-object decision to recycle or be destroyed

```
interface IObjectControl : IUnknown {
  HRESULT Activate();
  void    Deactivate();
  BOOL    CanBePooled();
}
```

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object pooling and jita

- Classes can also be configured to support just-in-time activation to further control association with context
  - JITA contexts maintain a "done" bit
  - Object is deactivated when leaving a method with done=true
  - Object will then be destroyed *unless* pooling=true
  - Next call from proxy will activate an object from inventory or create a new instance

```
interface IContextState : IUnknown {
  HRESULT SetDeactivateOnReturn([in] VARIANT_BOOL bDone);
  HRESULT GetDeactivateOnReturn(
                    [out,retval] VARIANT_BOOL *pbDone);
// remaining methods elided for clarity
}
```

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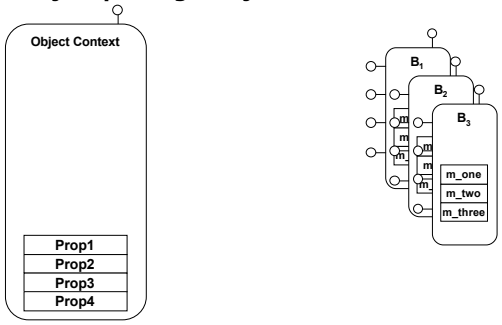
object pooling and jita



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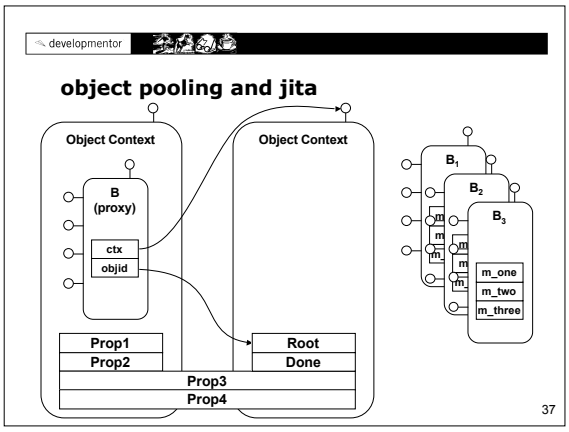

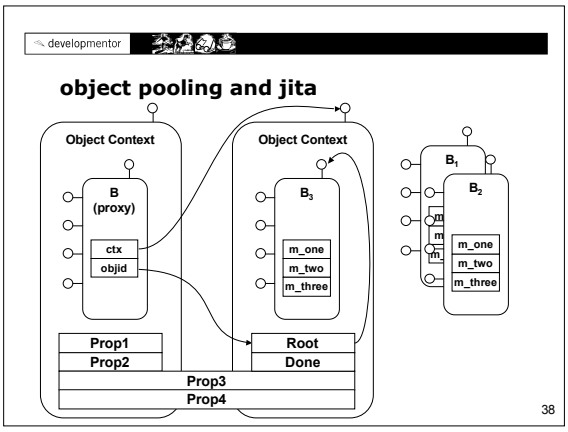

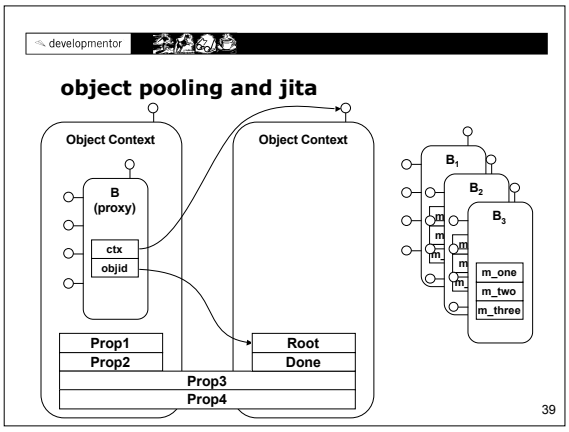

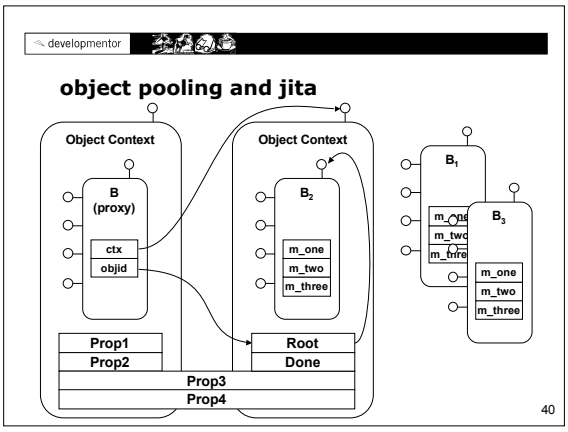

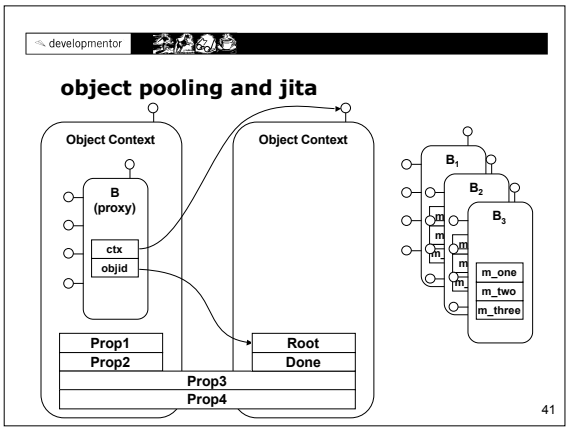

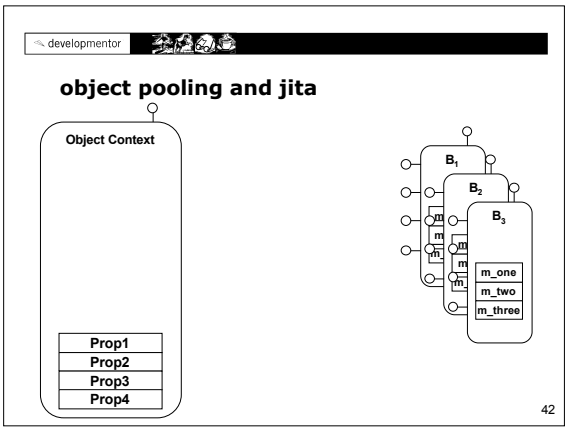

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attribute/context examples: ThreadingModel/Apartments

- COM groups objects into apartments based on the ThreadingModel attribute
  - An apartment is a group of contexts in a process that map to a particular thread (or set of threads)
  - Apartments are used to control thread affinity
  - Apartment logically acts as a context property

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attribute/context examples: synchronization/activities

- COM groups objects into activites based on the Synchronization attribute
  - An activity is a group of contexts across the network in which no concurrency is expected or required
  - Activities are used to serialize access to a group of contexts within a process
  - Activities are used to allocate STA-based contexts intelligently

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attribute/context examples: Transaction/Transaction Streams

- COM groups objects into transaction streams based on the Transaction attribute
  - A TxStream is a group of contexts across an activity whose work must be composed into an atomic transaction
  - TxStreams are used to manage concurrency at an application-level
  - Transactions are used to manage failure recovery

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attribute/context examples: msmq accessible types (QC)

- Configured classes can be configured to support access via MSMQ-based proxies
  - Proxy (QC Recorder) sends batched calls at deactivation
  - Proxy only supports interfaces marked *queueable*
  - Process/Application-level dispatcher handles poison message + security grunge

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attribute/context examples: Type-based Publish/Subscribe (LCE)

- COM's publish/subscribe system based on special type of configured class called an event class
  - Event class's catalog entry contains list of subscriber classes
  - All method calls are broadcast to subscriber instances
  - Event class's code totally synthetic – driven by TLB
  - Context can flow from publisher to event class to subscribers

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attribute/context examples: IIS/WAM/ASP

- IIS dispatches HTTP requests through a configured COM+ component called the WAM
  - Used to manage processes in a web server
  - Security uses context plumbing to dispatch calls under correct security principal
  - ASP adds HTTP-specific properties to context

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summary

- COM components are typed and self-describing
- COM object references are typed via abstract interfaces
- COM objects are typed via concrete classes
- COM classes can be annotated via declarative attributes
- Attributes use context to augment instances of classes
- Most COM+ 1.0 services exposed via attributes and context

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