Extensibility in GNUstep & Étoilé

GNU Hackers 2011

http://www.gnustep.org

http://www.etoileos.com

Objective-C
&
GNUstep

Objective-C

- Created by Brad Cox and Tom Love in 1986 to package C libraries in Smalltalk-like classes
- Comes with dynamic features such as
  - message forwarding
  - categories to extend existing classes
  - resolve methods lazily etc.

Class Example

```
@interface Person : NSObject
- (void) sleep;
@end
@implementation
- (void) sleep {
    NSLog(@“Zzzz!”);
}
@end
```

Category Example

```
@interface Person (Talktative)
- (NSString *) talk;
@end
@implementation Person (Talktative)
- (NSString *) talk {
	return @“poumpoumpidoum”;
}
@end
```

Objective-C Runtime

- No virtual machine, but a small runtime library
  - class_getSuperclass()
  - class_setSuperclass()
  - class_replaceMethod()
  - method_getArgumentType() etc.
- Provides type infos for C types such as structs, unions, pointer etc.

Class Transform

- Dynamic implicit subclass creation
- Many Use cases
  - Persistency (Fast Portable Orthogonally Persistent Java)
  - Change Notifications (Key Value Observing)
  - Prototypes (Google V8, libobjc2)
  - Faulting, State Machine, AOP etc.

Composition of Class Transforms

- Multiple transforms create several implicit subclasses…
  - Methods can be overriden several times
    - Composition order matters
- How to be sure the resulting behavior is correct?
  - No well-known model to support composition

Safe Composition of Class Transforms

- V8, libobjc2 and Foundation approach
  - restricts the supported transforms to the core language or library level
  - hides the implicit subclass

```
id obj = [A new]

objc_setAssociatedReference(obj, key, value, retainPolicy)

[[obj class] isEqual: object_getClass(obj)] // A in both cases
```

Class Cluster

- Variation on the Abstract class idea
  - A single public Class
  - Multiples concrete implementation classes
- The public class initializer and copy methods choose the class of the returned object
- For example… NSSet, NSArray, NSNumber, NSString etc.

NSString Class Cluster

- GSPlaceholderString
- GSString
  - GSCString
    - GSCBufferString
    - GSCInlineString
    - GSCSubString
  - GSUnicodeString (same subclasses than GSCString)

Class Cluster

- In theory very nice :-)
- In practice…
  - Poorly documented API contracts by Apple
  - No way to register new implementations and control how the concrete classes are choosen

Class Registration

- Extra classes loaded on-demand to provide new abilities e.g.
  - reading/writing new document format
- Registration API involves method such as
  - +registerClass:
  - +unregisterClass:
  - +registeredClasses

NSImage Example

```
[NSImageRep registerImageRepClass: [MySVGImageRep class]];

NSImage *img =
    [[NSImage alloc] initWithContentsOfFile: @“~/tiger.svg”];

// [img representations] contains a MySVGImageRep instance
```

Drawing Backend Example

- GNUstep imaging is based on the DisplayPostScript model
- NSGraphicsContext is the public API and an abstract class
- Concrete subclasses adapts the DPS model to various drawing libs e.g. Cairo, Xlib, GDI
    - CairoContext, XGContext, WIN32Context

Drawing Backend Example

- NSGraphicsContext is part of the AppKit framework
- While each concrete subclass is located in a bundle that is choosen at launch time
- System/Library/Bundles can contain *libgnustep-xlib.bundle* or *libgnustep-cairo.bundle*
- *defaults write MyApp GSBackend libgnustep-cairo*

Étoilé

Étoilé

A desktop environment built around

- Pervasive Data Sharing & Versioning
- Composite Document
- Collaboration
- Light & Focused Applications (1000 loc max per app)

Étoilé Today

Well, presently more or less a development platform centered around

- LanguageKit
- CoreObject
- EtoileUI

Small in the long run

- An entire desktop environment in 150 000 loc
  - atop GNUstep and some other dependencies such as LLVM, FFmpeg, TagLib etc.
- Most frameworks are between 2 000 and 6 000 loc
- Only two frameworks are above 10 000 loc
  - LanguageKit
  - EtoileUI

LanguageKit

LanguageKit

- A framework to build dynamic languages based on the ObjC object model
- Small and modular
  - ~ 15 000 loc
- Fast…

Already Fast…

- LLVM built-in passes
- Small objects hidden in pointers (e.g. efficient integer computation)
- The new GNUstep runtime comes with
  - various extra passes
  - type feedback to generate profiling infos related to call sites…

ObjC Runtime Passes

- Cached lookup
  - fragile instance variable and class access
  - classes messages
  - messages in a loop
- Method inlining
  - class methods
  - speculative

Benchmarks

- Almost the same speed as C integer arithmetic e.g. Fibonacci benchmark ran the same speed as GCC 4.2.1
- With all optimizations, can be faster than C in some micro-benchmarks
- Probably 5 to 10 times the speed than an open source Smalltalk such as Squeak
- Floating point still slow but will become fast soon :-)

Primitive Support

- Automatically box and unbox primitive types such as int, float etc.
- Integer operations/methods as C functions, compiled to bitcode and inlined by LLVM
- *4 + 4* in Smalltalk is as fast as C
- As a bonus, C direct library access without FFI, just do *C sqrt: 42* for *sqrt(42)*

Modular

Composed of several components in separate libraries

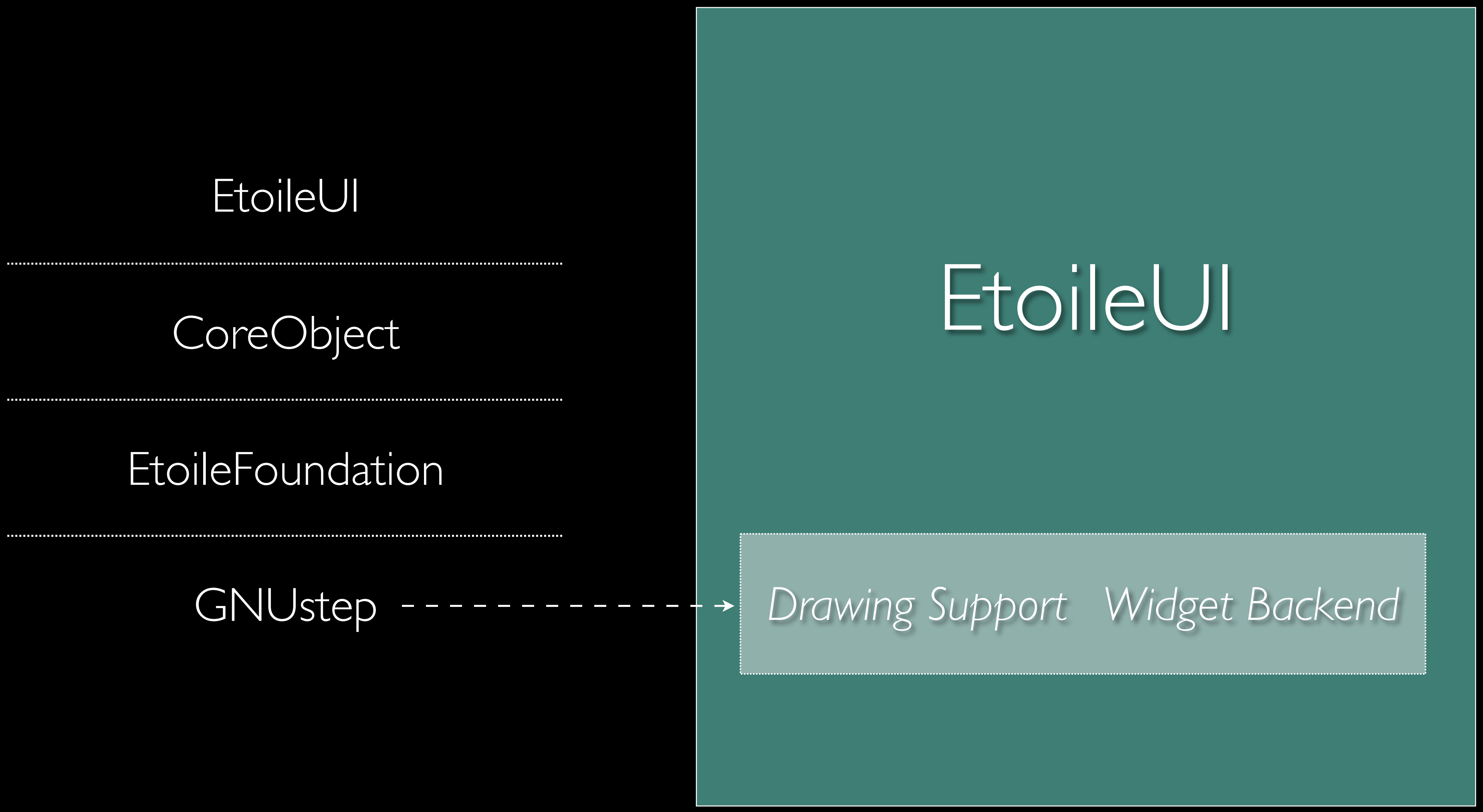
- An AST geared towards dynamic languages bundled with an AST interpreter
- A code generator-based on LLVM (JIT or static compilation)
- Two language front-ends (Smalltalk, EScript currently)

Mixing Languages

- Methods written in EScript, Smalltalk and ObjC
  - can belong to the same object
  - can call each other
- You can clone an object in EScript then pass it around to some Smalltalk or ObjC code
- ObjC and Smalltalk blocks are interchangeable

EtoileUI

Bird View


EtoileUI
CoreObject
EtoileFoundation
GNUstep
EtoileUI
Drawing Support
Widget Backend

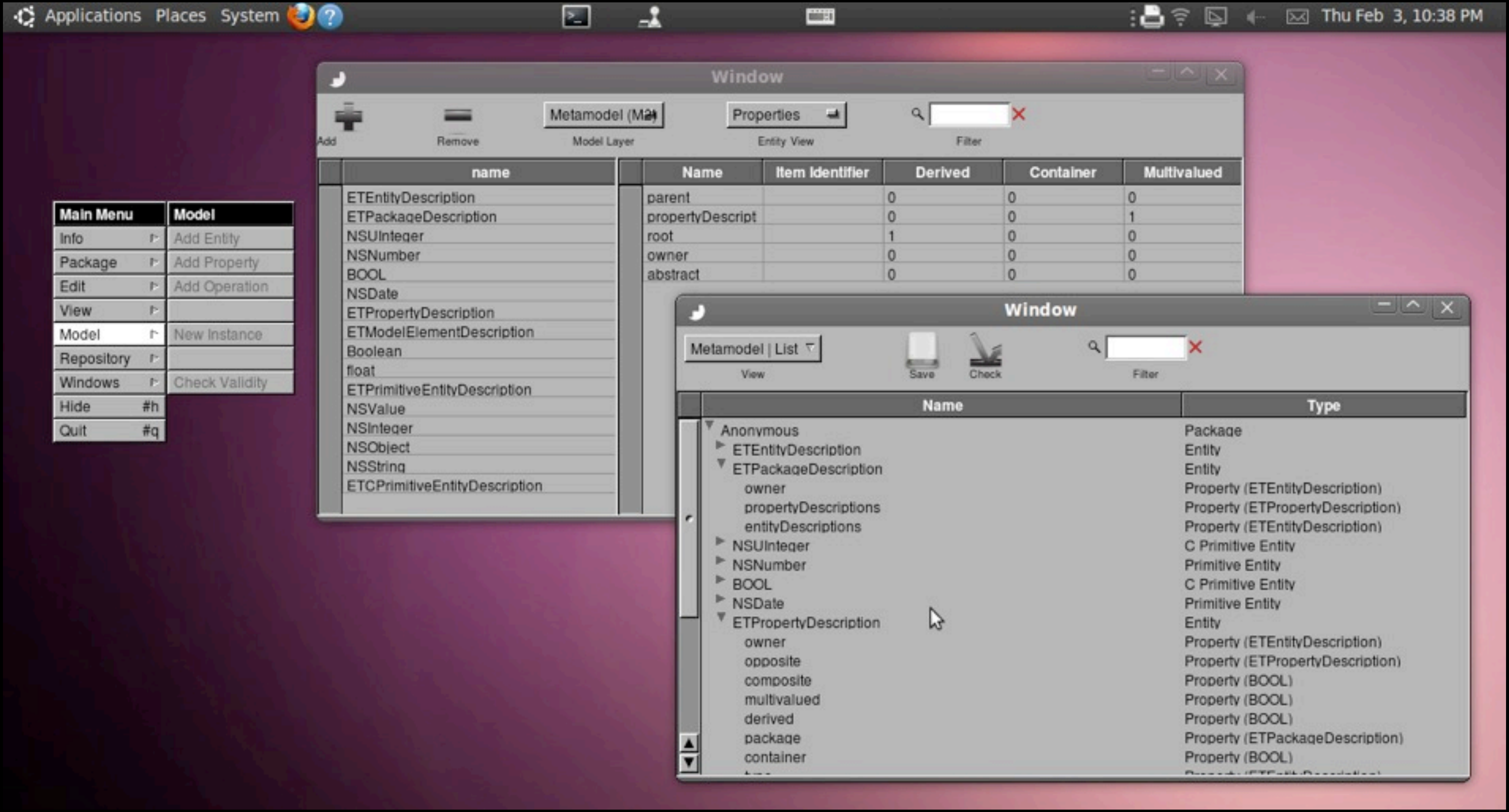
Surprisingly Small

- Found on Digg (in 2007)…
- Konqueror itself is really a surprisingly small app: approx 40k lines of code. Not tiny, by any stretch of the imagination, but way, way smaller than people seem to think it is.
- 40x what is allowed in Étoilé :-/

From: http://digg.com/linux_unix/Nautilus_vs_Dolphin_vs_Konqueror

Code Compression

- Étoilé Generic Object Manager
  - *700 loc*
- Étoilé Model Builder
  - *1 000 loc*



name
ETEntityDescription
ETPackageDescription
NSUInteger
NSNumber
BOOL
NSDate
ETPropertyDescription
ETModelElementDescription
Boolean
float
ETPrimitiveEntityDescription
NSValue
NSInteger
NSObject
NSString
ETCPrimitiveEntityDescription

Name	Item Identifier	Derived	Container	Multivalued
parent		0	0	0
propertyDescript		0	0	1
root		1	0	0
owner		0	0	0
abstract		0	0	0

Name	Type
Anonymous	Package
ETEntityDescription	Entity
ETPackageDescription	Entity
owner	Property (ETEntityDescription)
propertyDescriptions	Property (ETPropertyDescription)
entityDescriptions	Property (ETEntityDescription)
NSUInteger	C Primitive Entity
NSNumber	Primitive Entity
BOOL	C Primitive Entity
NSDate	Primitive Entity
ETPropertyDescription	Entity
owner	Property (ETEntityDescription)
opposite	Property (ETPropertyDescription)
composite	Property (BOOL)
multivalued	Property (BOOL)
derived	Property (BOOL)
package	Property (ETPackageDescription)
container	Property (BOOL)

Model Builder
Editing a package & browsing a repository

Post-WIMP?

- From the whole screen to a single row in a list view…
- It’s just an uniform tree structure
- No special window, list or row node

Why?

An existing application should be easy to retarget

- personal computer
- mobile phone
- tablet
- web

Why a “new” UI toolkit?

- Everything can be changed at runtime
- Simple, compact and highly polymorphic API
- Write less code and develop faster
- Feeling of manipulating real objects

What does it solve?

- Generic protocol for Structured Document
- Building blocks for Graphics Editor
- Custom widget development
- As little code as possible
- Plasticity

Separation of Concerns

- No monolithic view/wigdet, but rather…
- UI aspects
  - Styles, Decorators, Layouts
  - Tools, Action Handlers
  - Widgets
  - Model Objects, Controllers

Turtles all the way down

Many things are just layout items

- selection rectangle
- handles
- shapes
- windows
- layers

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