Building GUIs

Lean versus Big Builders

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Oct 7, 2003

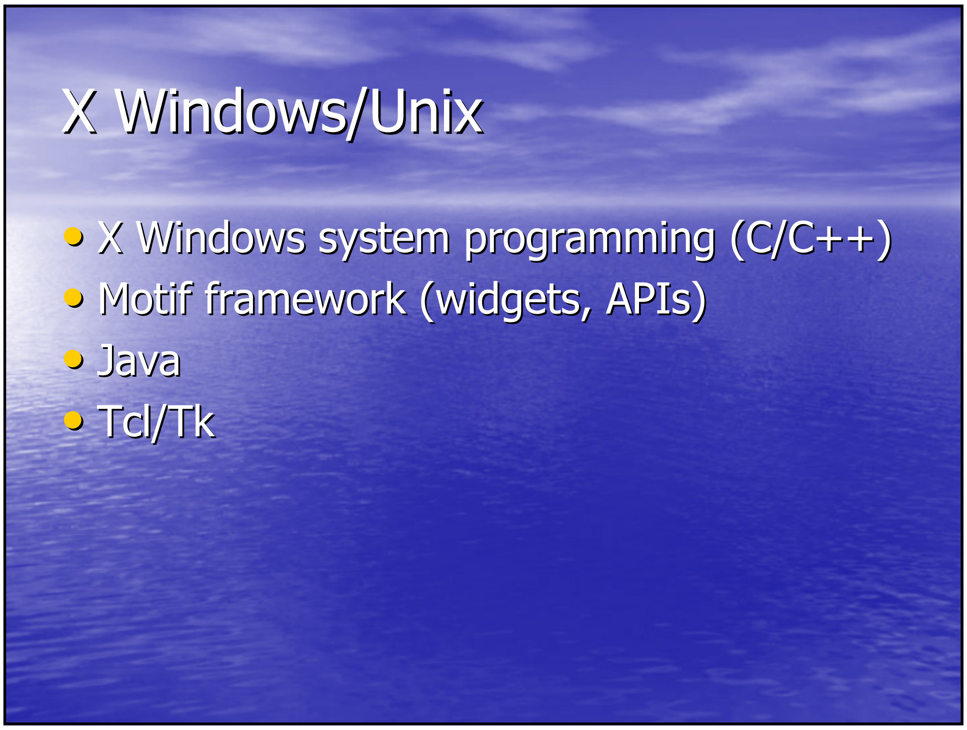
Windowing systems

- Apple Macintosh
- X Windows/Unix
- Microsoft Windows
- others…

GUI building technologies

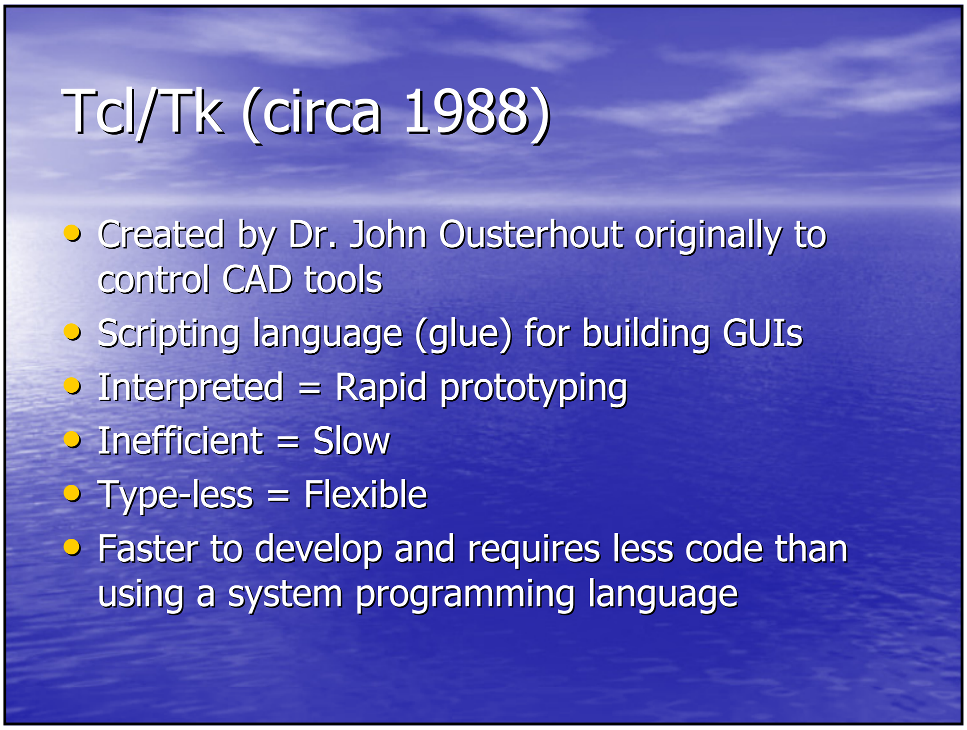
- Systems level programming
- Tcl/Tk
- GUI frameworks
- Component-oriented development
- Graphical GUI tools
- Composite applications
- Compound documents & containers
- Web pages

X Windows/UNIX Programming



X Windows/Unix

- X Windows system programming (C/C++)
- Motif framework (widgets, APIs)
- Java
- Tcl/Tk



Tcl/Tk (circa 1988)

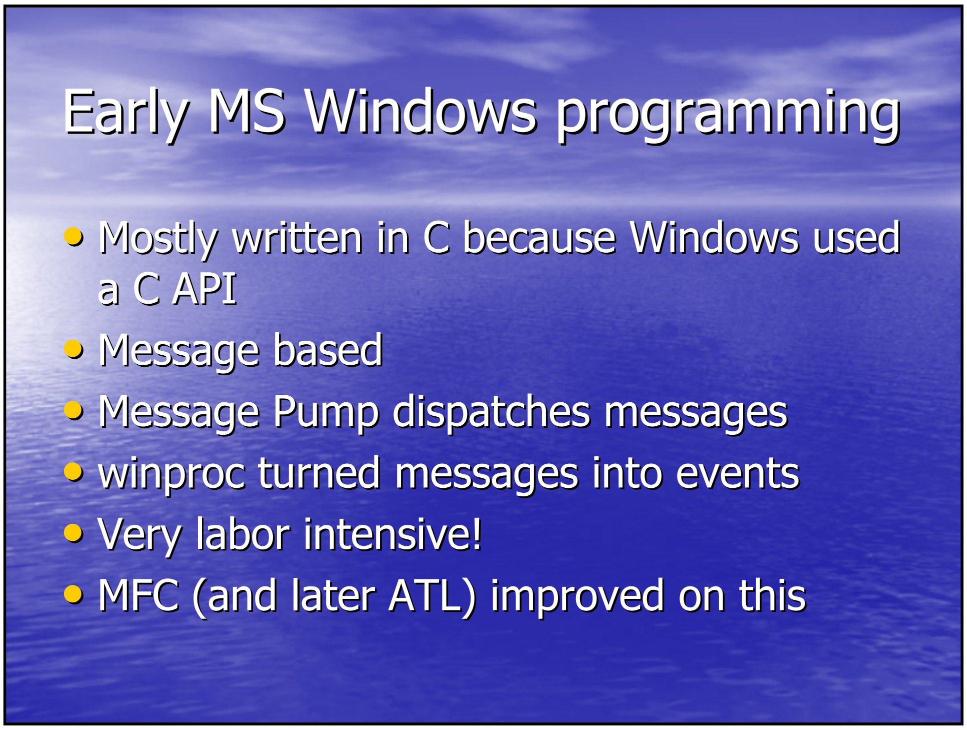
- Created by Dr. John Ousterhout originally to control CAD tools
- Scripting language (glue) for building GUIs
- Interpreted = Rapid prototyping
- Inefficient = Slow
- Type-less = Flexible
- Faster to develop and requires less code than using a system programming language

Tcl/Tk cont'd

- Tcl (Tool Command Language) ("tickle") is the scripting language
- Tk is a graphical toolkit (widgets, buttons, labels, etc.)
- Wish is a windowing shell for Tcl
- Wish interprets Tcl to build graphical components using the Tk toolkit

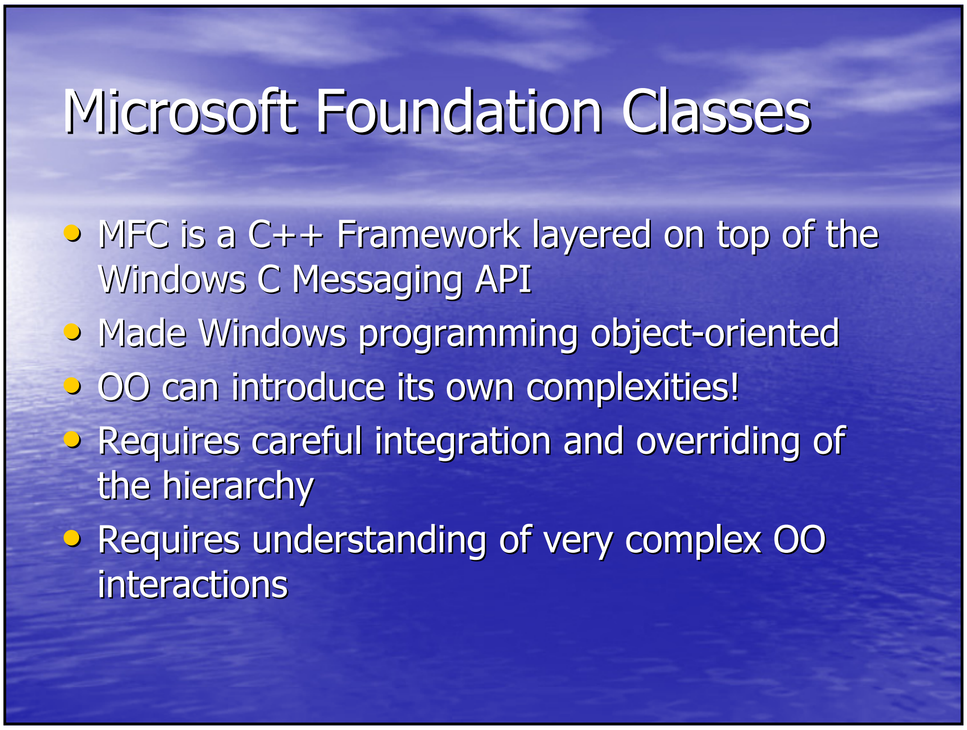
```
button .submit -text "Click Me" -command {
   puts "\nHello World" }:
```

Microsoft Windows Programming



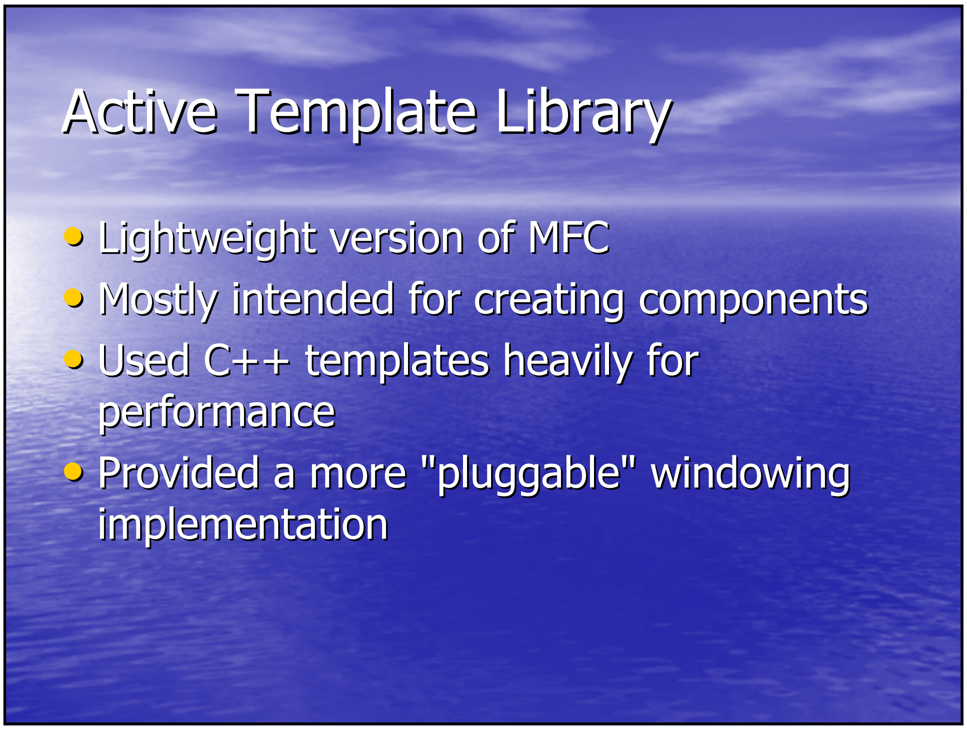
Early MS Windows programming

- Mostly written in C because Windows used a C API
- Message based
- Message Pump dispatches messages
- winproc turned messages into events
- Very labor intensive!
- MFC (and later ATL) improved on this



Microsoft Foundation Classes

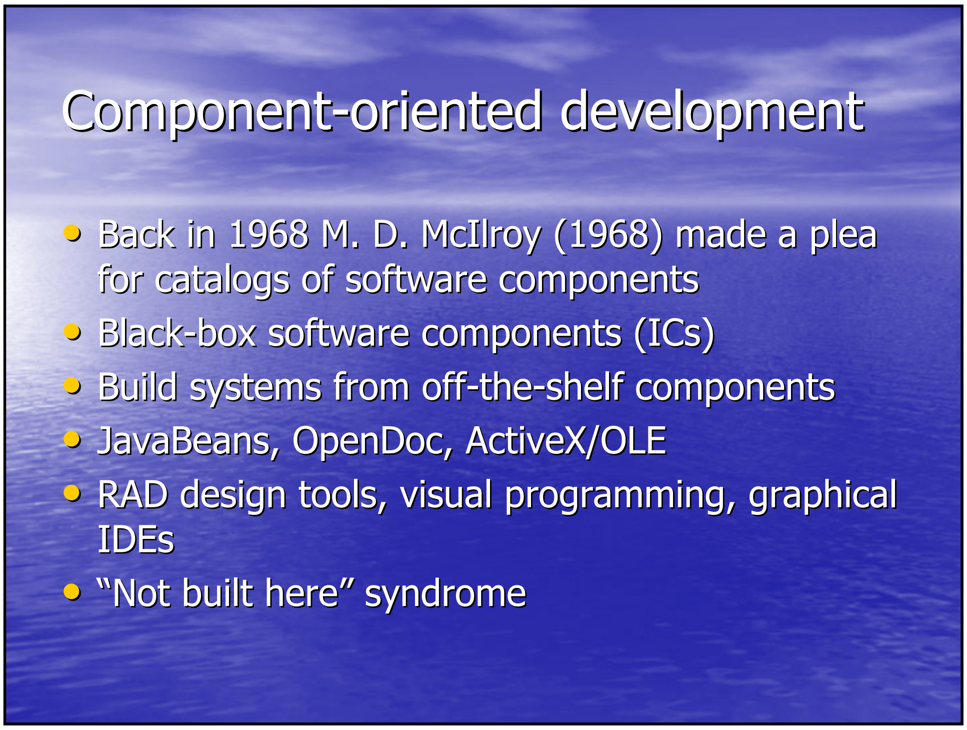
- MFC is a C++ Framework layered on top of the Windows C Messaging API
- Made Windows programming object-oriented
- OO can introduce its own complexities!
- Requires careful integration and overriding of the hierarchy
- Requires understanding of very complex OO interactions



Active Template Library

- Lightweight version of MFC
- Mostly intended for creating components
- Used C++ templates heavily for performance
- Provided a more "pluggable" windowing implementation

Components



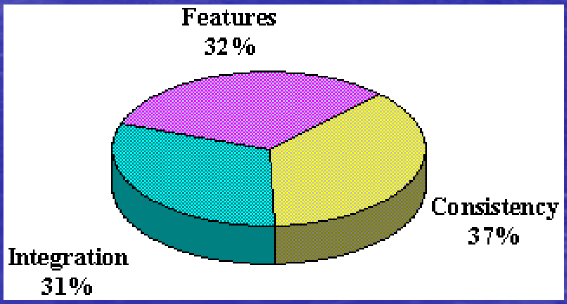
Component-oriented development

- Back in 1968 M. D. McIlroy (1968) made a plea for catalogs of software components
- Black-box software components (ICs)
- Build systems from off-the-shelf components
- JavaBeans, OpenDoc, ActiveX/OLE
- RAD design tools, visual programming, graphical IDEs
- “Not built here” syndrome

ActiveX

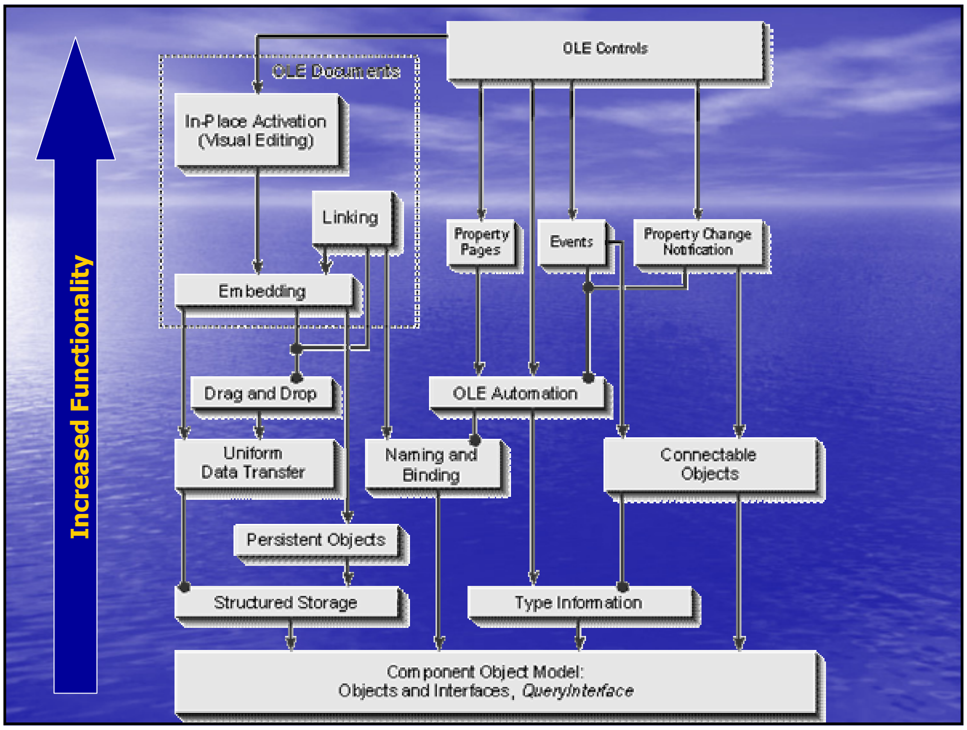
Motivation

- Microsoft research showed that customer demands fell into three categories: new features, integration between applications, and consistency between applications



OLE97 control specification

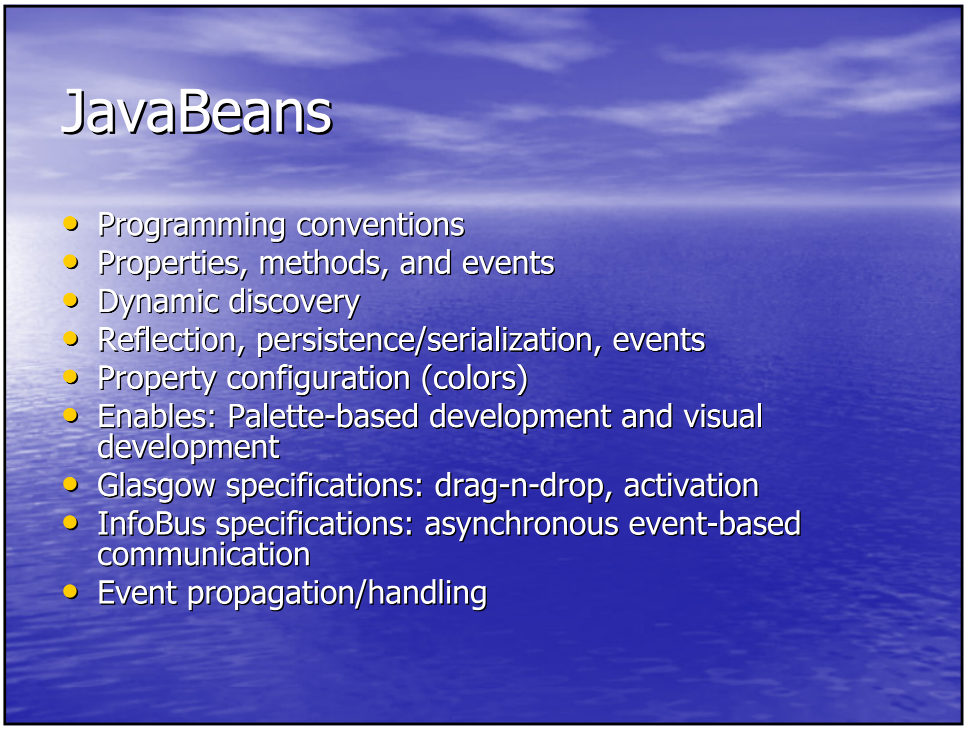
- Object Linking and Embedding
- VBX -> OLE -> ActiveX
- Interface standards
- Binary standard (COM)
- Uniform Data Transfer (copy-cut-paste, drag-n-drop)
- Connectable objects (events)
- Type info/reflection
- Activation (visual editing), keystrokes, focus, menu/toolbar merging, sizing
- Storage/persistence ("pickling")
- Automation/scripting
- Property pages



ActiveX (OLE)

- Componentized UI widgets
- Created using VB, MFC or ATL (although any language or OS can be used)
- Large specification
- Complex interactions with slightly different implementations
- Enabled black box reuse

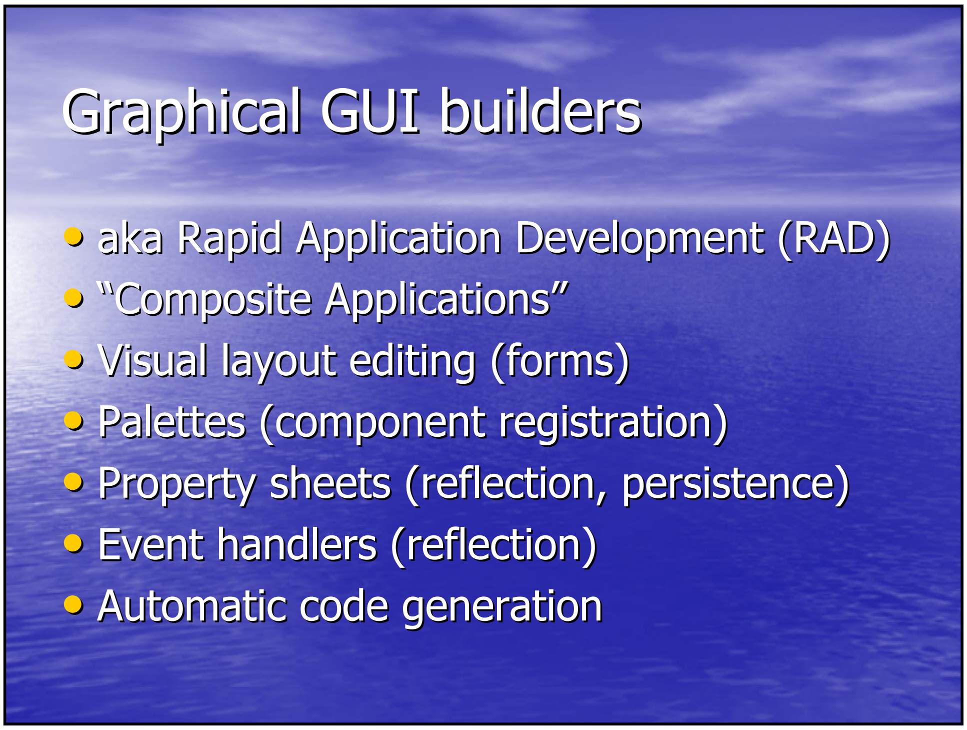
JavaBeans



JavaBeans

- Programming conventions
- Properties, methods, and events
- Dynamic discovery
- Reflection, persistence/serialization, events
- Property configuration (colors)
- Enables: Palette-based development and visual development
- Glasgow specifications: drag-n-drop, activation
- InfoBus specifications: asynchronous event-based communication
- Event propagation/handling

Graphical GUI Builders



Graphical GUI builders

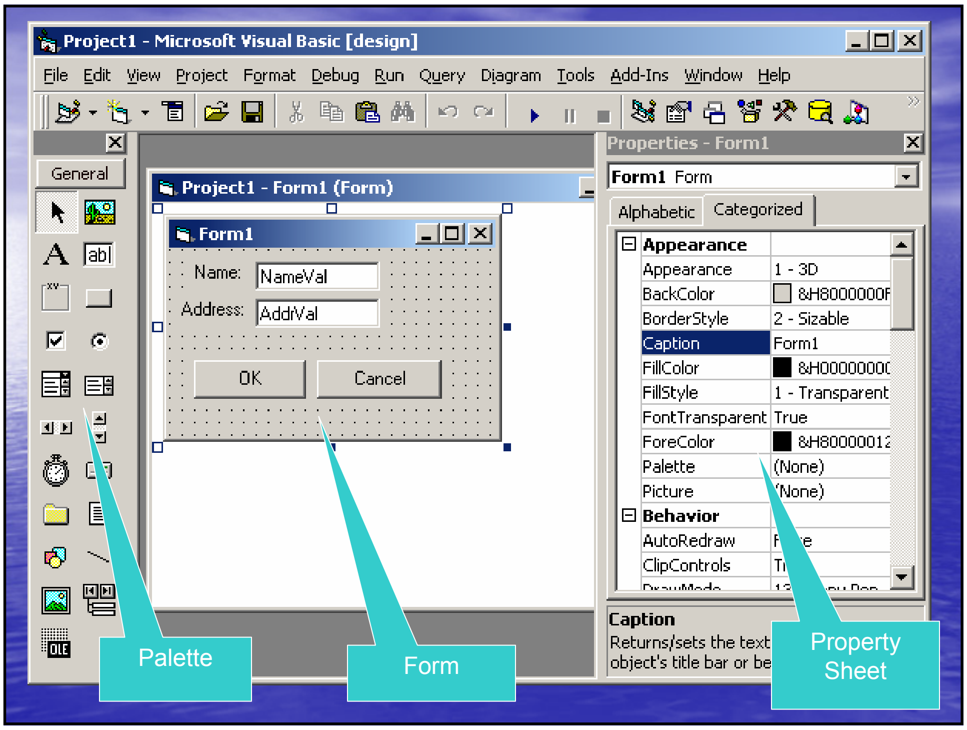
- aka Rapid Application Development (RAD)
- "Composite Applications"
- Visual layout editing (forms)
- Palettes (component registration)
- Property sheets (reflection, persistence)
- Event handlers (reflection)
- Automatic code generation

Example GUI builders

- Visual Basic (VB, ActiveX)
- NetBeans, VisualAge, Forte, JBuilder, Eclipse, etc. etc. (Java, JavaBeans)
- Visual Studio (MFC, ActiveX, C++, C#, VB.NET, etc.)
- FrontPage, Dreamweaver (HTML)
- Delphi Studio (Delphi, VCL)
- Tk (Tcl)
- X Designer (C++, Java, Ada, etc.)
- Interface Builder/XCode/CodeWarrior/Cocoa (Apple, C++, Java)

Visual Basic

- Controls adhere to ActiveX UI standard
- Also supports standard Windows controls
- Uses ActiveX type information for reflection, property sheets, persistence


Project1 - Microsoft Visual Basic [design]
File Edit View Project Format Debug Run Query Diagram Tools Add-Ins Window Help
General
Project1 - Form1 (Form)
Form1
OK
Cancel
Properties - Form1
Alphabetic
Categorized
Palette
Form
Property Sheet

Name: NameVal

Address: AddrVal

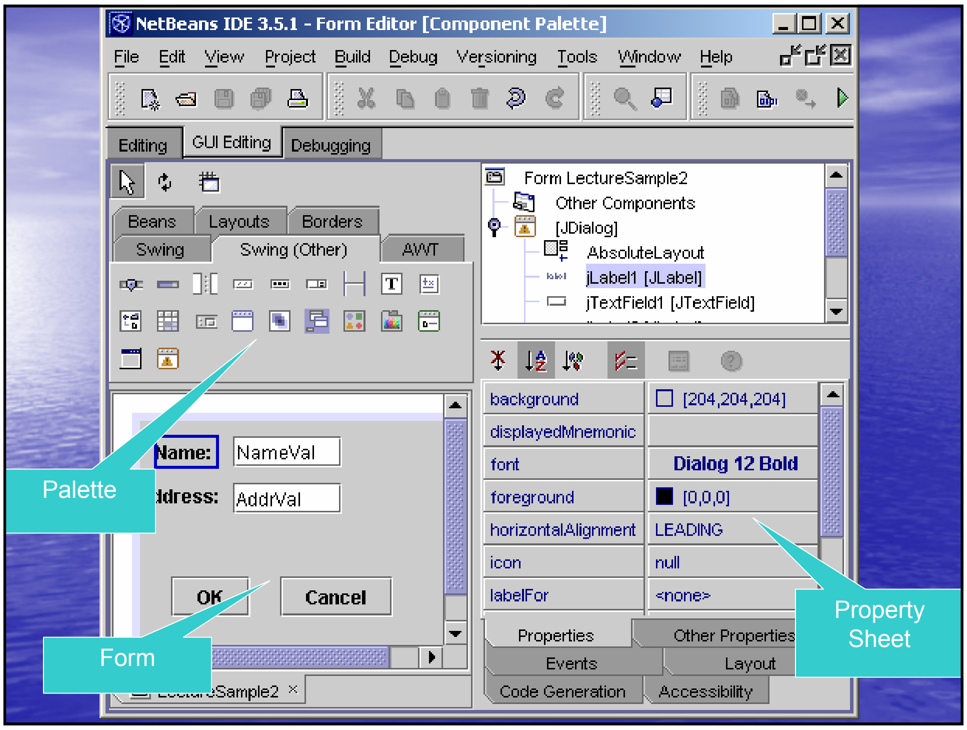
Form1 Form

⊟ **Appearance**	
Appearance	1 - 3D
BackColor	⬜ &H8000000F
BorderStyle	2 - Sizable
Caption	Form1
FillColor	⬛ &H00000000
FillStyle	1 - Transparent
FontTransparent	True
ForeColor	⬛ &H80000012
Palette	(None)
Picture	(None)
⊟ **Behavior**	
AutoRedraw	F[illegible]e
ClipControls	T[illegible]

Caption
Returns/sets the text
object's title bar or be

NetBeans

- Controls adhere to JavaBeans UI standard
- Also supports AWT and Swing controls
- Uses Java Reflection API for reflection
- Uses BeanInfo API for property sheets
- Uses Java Serialization API for persistence

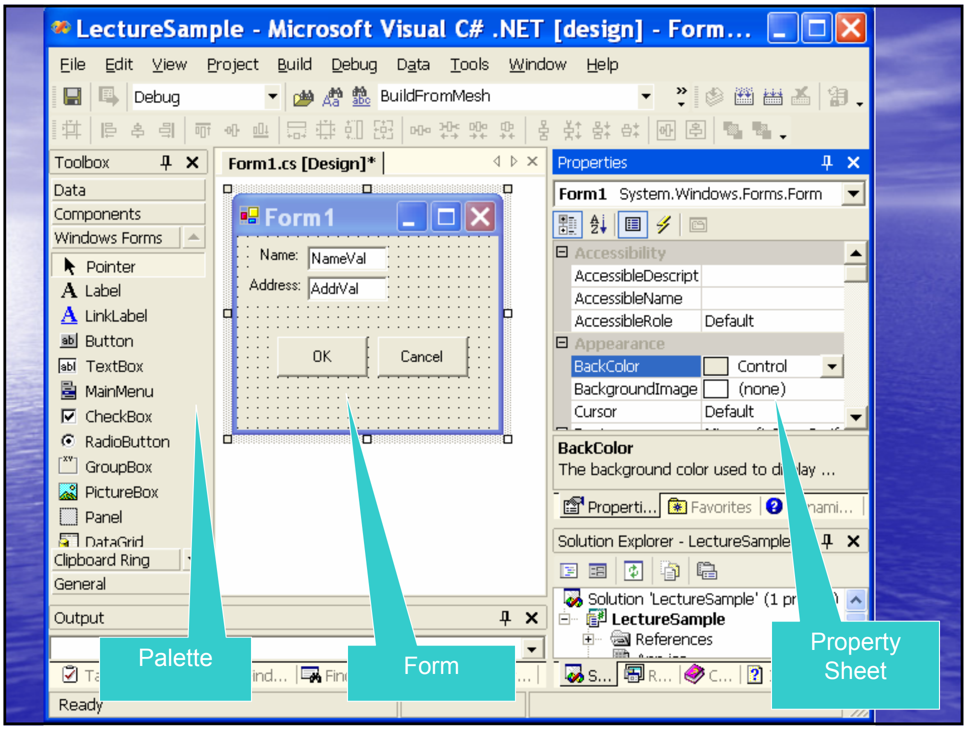

NetBeans IDE 3.5.1 - Form Editor [Component Palette]
File Edit View Project Build Debug Versioning Tools Window Help
Editing GUI Editing Debugging
Beans Layouts Borders
Swing Swing (Other) AWT
Name: NameVal
ddress: AddrVal
OK Cancel
LectureSample2
Properties Other Properties
Events Layout
Code Generation Accessibility
Palette
Form
Property Sheet

Form LectureSample2
- Other Components
- [JDialog]
  - AbsoluteLayout
  - jLabel1 [JLabel]
  - jTextField1 [JTextField]

background	[204,204,204]
displayedMnemonic	
font	Dialog 12 Bold
foreground	■ [0,0,0]
horizontalAlignment	LEADING
icon	null
labelFor	<none>

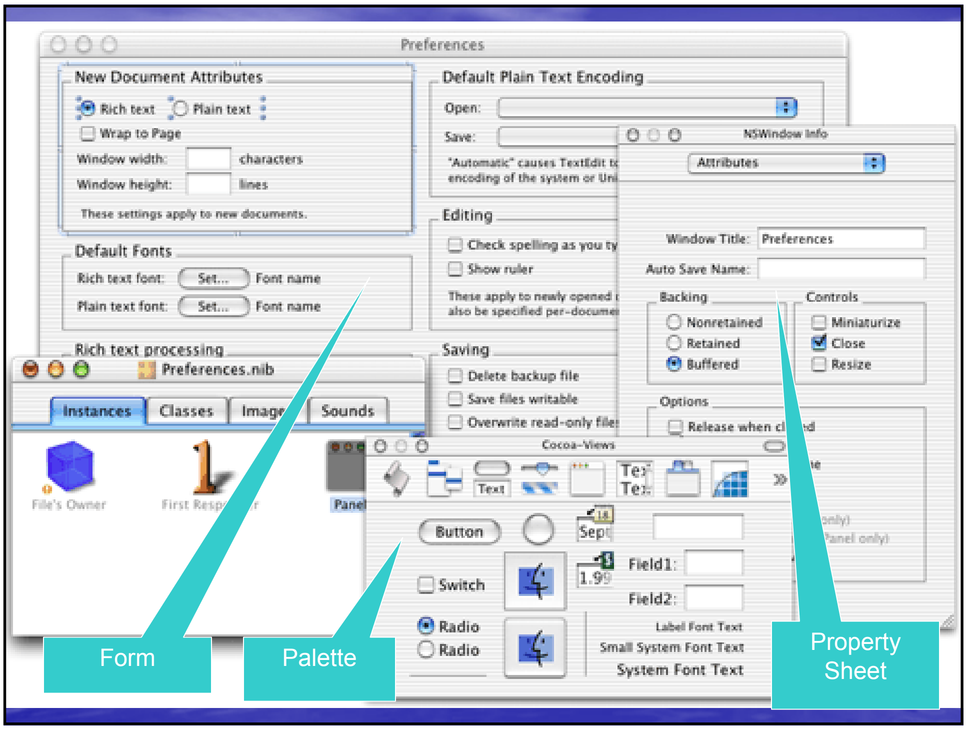
Visual Studio .NET

- Supports .NET languages (C#, VB.NET)
- MetaData used for Reflection, Property Sheets



Apple Interface Builder

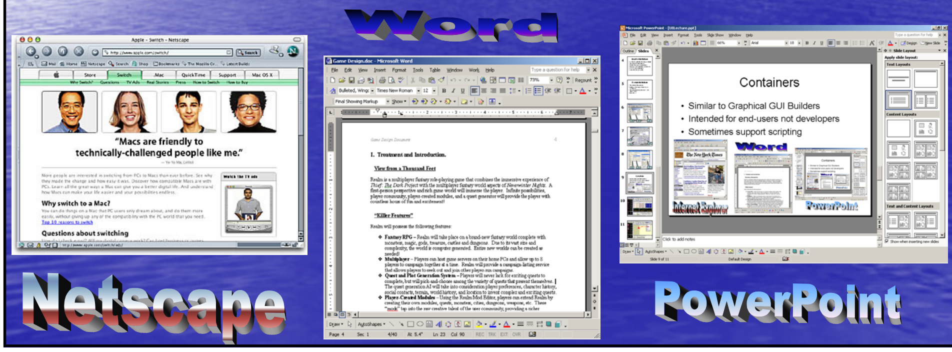
- GUI tool for designing applications for Mac OS X



Containers & compound documents

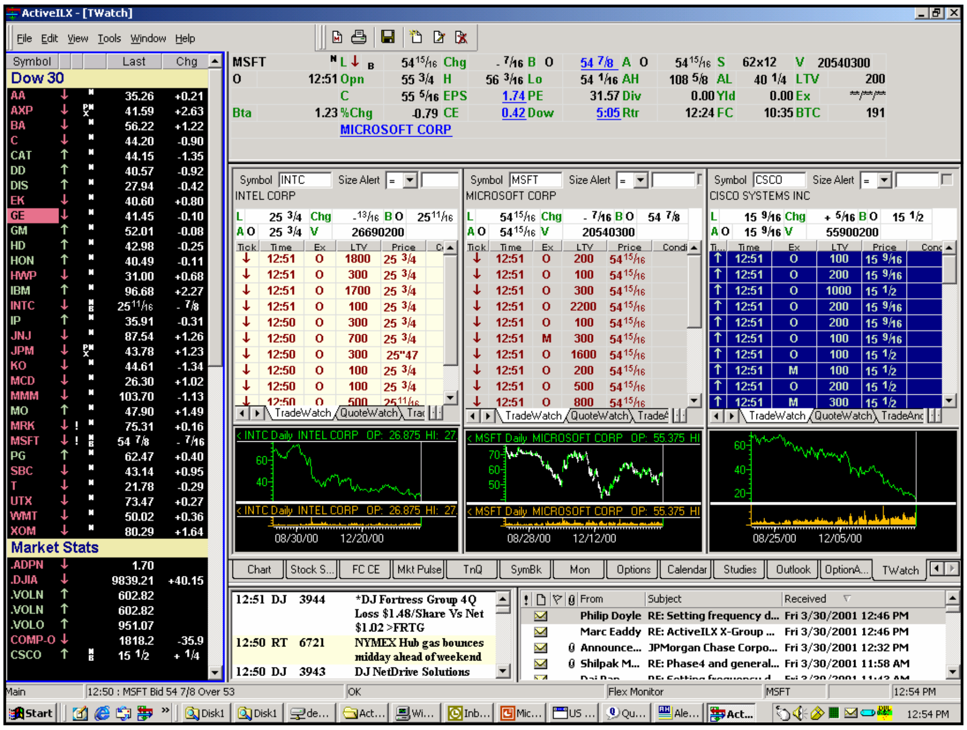
Containers & compound documents

- Similar to Graphical GUI Builders
- Intended for end users not developers
- Sometimes support scripting/automation


Word
Netscape
PowerPoint
"Macs are friendly to technically-challenged people like me."
Containers
Similar to Graphical GUI Builders
Intended for end-users not developers
Sometimes support scripting

ActiveILX

- Project I worked on at ILX Systems
- ActiveX control container
- Controls displayed real-time market data
- Control interactions were scripted
- Componentized development is hard!
- Standard interfaces are essential
- However, benefits outweigh costs



Symbol	Last	Chg
Dow 30		
AA	35.26	+0.21
AXP	41.59	+2.63
BA	56.22	+1.22
C	44.20	-0.90
CAT	44.15	-1.35
DD	40.57	-0.92
DIS	27.94	-0.42
EK	40.60	+0.80
GE	41.45	-0.10
GM	52.01	-0.08
HD	42.98	-0.25
HON	40.49	-0.11
HWP	31.00	+0.68
IBM	96.68	+2.27
INTC	25 11/16	- 7/8
IP	35.91	-0.31
JNJ	87.54	+1.26
JPM	43.78	+1.23
KO	44.61	-1.34
MCD	26.30	+1.02
MMM	103.70	-1.13
MO	47.90	+1.49
MRK	75.31	+0.16
MSFT	54 7/8	- 7/16
PG	62.47	+0.40
SBC	43.14	+0.95
T	21.78	-0.29
UTX	73.47	+0.27
WMT	50.02	+0.36
XOM	80.29	+1.64
Market Stats		
.ADPN	1.70	
.DJIA	9839.21	+40.15
.VOLN	602.82	
.VOLN	602.82	
.VOLO	951.07	
COMP-O	1818.2	-35.9
CSCO	15 1/2	+ 1/4

Tick	Time	Ex	LTV	Price
↓	12:51	O	1800	25 3/4
↓	12:51	O	300	25 3/4
↓	12:51	O	1700	25 3/4
↓	12:51	O	100	25 3/4
↓	12:50	O	300	25 3/4
↓	12:50	O	700	25 3/4
↓	12:50	O	300	25"47
↓	12:50	O	100	25 3/4
↓	12:50	O	100	25 3/4
↓	12:50	O	500	25 11/16

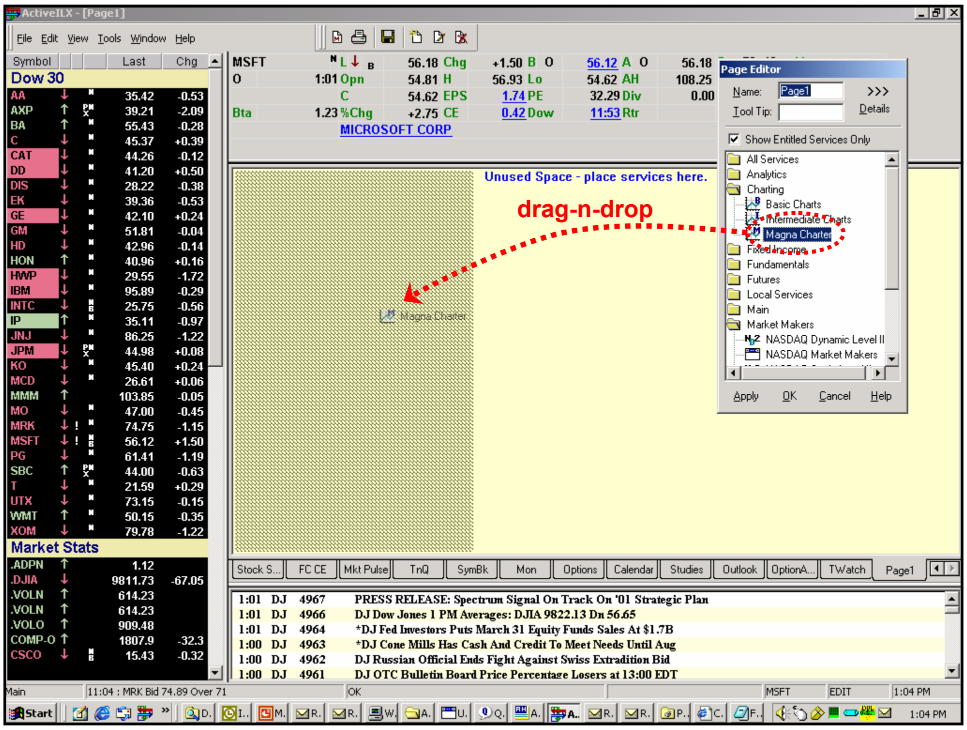
Tick	Time	Ex	LTV	Price
↓	12:51	O	200	54 15/16
↓	12:51	O	100	54 15/16
↓	12:51	O	300	54 15/16
↓	12:51	O	2200	54 15/16
↓	12:51	O	100	54 15/16
↓	12:51	M	300	54 15/16
↓	12:51	O	1600	54 15/16
↓	12:51	O	200	54 15/16
↓	12:51	O	500	54 15/16
↓	12:51	O	800	54 15/16

Tick	Time	Ex	LTV	Price
↑	12:51	O	100	15 9/16
↑	12:51	O	200	15 9/16
↑	12:51	O	1000	15 1/2
↑	12:51	O	200	15 9/16
↑	12:51	O	100	15 9/16
↑	12:51	O	100	15 9/16
↑	12:51	O	100	15 1/2
↑	12:51	M	100	15 1/2
↑	12:51	O	200	15 1/2
↑	12:51	M	300	15 1/2

12:51 DJ 3944 *DJ Fortress Group 4Q Loss $1.48/Share Vs Net $1.02 >FRTG
12:50 RT 6721 NYMEX Hub gas bounces midday ahead of weekend
12:50 DJ 3943 DJ NetDrive Solutions

From	Subject	Received
Philip Doyle	RE: Setting frequency d...	Fri 3/30/2001 12:46 PM
Marc Eaddy	RE: ActiveILX X-Group ...	Fri 3/30/2001 12:46 PM
Announce...	JPMorgan Chase Corpo...	Fri 3/30/2001 12:32 PM
Shilpak M...	RE: Phase4 and general...	Fri 3/30/2001 11:58 AM

Main | 12:50 : MSFT Bid 54 7/8 Over 53 | OK | Flex Monitor | MSFT | 12:54 PM

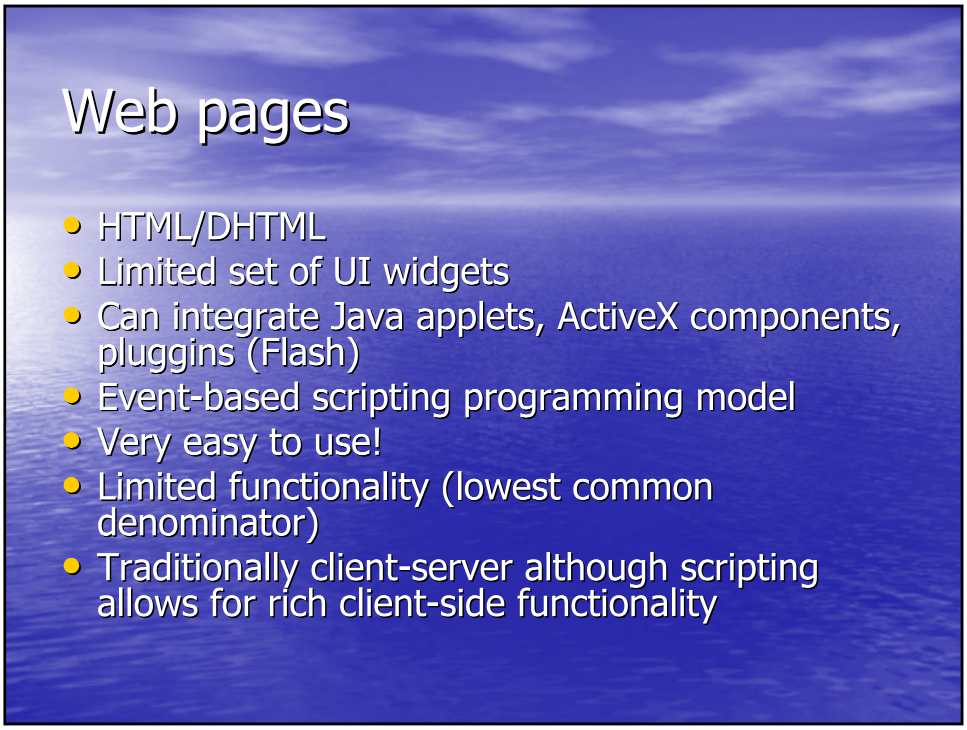


Name: Page1
Tool Tip:
☑ Show Entitled Services Only
All Services
Analytics
Charting
Basic Charts
Intermediate Charts
Magna Charter
Fixed Income
Fundamentals
Futures
Local Services
Main
Market Makers
NASDAQ Dynamic Level II
NASDAQ Market Makers

Symbol	Last	Chg
Dow 30		
AA	35.42	-0.53
AXP	39.21	-2.09
BA	55.43	-0.28
C	45.37	+0.39
CAT	44.26	-0.12
DD	41.20	+0.50
DIS	28.22	-0.38
EK	39.36	-0.53
GE	42.10	+0.24
GM	51.81	-0.04
HD	42.96	-0.14
HON	40.96	+0.16
HWP	29.55	-1.72
IBM	95.89	-0.29
INTC	25.75	-0.56
IP	35.11	-0.97
JNJ	86.25	-1.22
JPM	44.98	+0.08
KO	45.40	+0.24
MCD	26.61	+0.06
MMM	103.85	-0.05
MO	47.00	-0.45
MRK	74.75	-1.15
MSFT	56.12	+1.50
PG	61.41	-1.19
SBC	44.00	-0.63
T	21.59	+0.29
UTX	73.15	-0.15
WMT	50.15	-0.35
XOM	79.78	-1.22
Market Stats		
.ADPN	1.12	
.DJIA	9811.73	-67.05
.VOLN	614.23	
.VOLN	614.23	
.VOLO	909.48	
COMP-O	1807.9	-32.3
CSCO	15.43	-0.32

1:01 DJ 4967 PRESS RELEASE: Spectrum Signal On Track On '01 Strategic Plan
1:01 DJ 4966 DJ Dow Jones 1 PM Averages: DJIA 9822.13 Dn 56.65
1:01 DJ 4964 *DJ Fed Investors Puts March 31 Equity Funds Sales At $1.7B
1:00 DJ 4963 *DJ Cone Mills Has Cash And Credit To Meet Needs Until Aug
1:00 DJ 4962 DJ Russian Official Ends Fight Against Swiss Extradition Bid
1:00 DJ 4961 DJ OTC Bulletin Board Price Percentage Losers at 13:00 EDT

Main | 11:04 : MRK Bid 74.89 Over 71 | OK | MSFT | EDIT | 1:04 PM



Web pages

- HTML/DHTML
- Limited set of UI widgets
- Can integrate Java applets, ActiveX components, pluggins (Flash)
- Event-based scripting programming model
- Very easy to use!
- Limited functionality (lowest common denominator)
- Traditionally client-server although scripting allows for rich client-side functionality