Windows™ *"Chicago"* Architecture

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What We'll Talk About

- "Chicago" user architecture
- "Chicago" kernel architecture
- "Chicago" GDI architecture

Windows *"Chicago"* User Architecture

Overview Of New User Features

- Increased system capacity
- Robustness additions
- Win32® API support
- New Win32 APIs to support new user features

Increased System Capacity

- Up to 32K menu and window handles (each)
- Number of timers limited only by available memory
- Unlimited number of COM and LPT ports
- List box item limits raise from 8K to 32K, with data limited only by available memory

Robustness Additions

- More robust parameter validation
- Each 32-bit or 16-bit process or thread ID is used for object ownership of Ring 3 objects
- All 32-bit applications and version 4.0-marked 16-bit applications have unfreed resources cleared at application termination time
- Existing Windows 3.x-based application resources are cleared when “Chicago” determines no other Windows 3.x-based applications are running

Robustness Additions

	Ring 3 objects	Tracked by:
User	Hooks	thread
	Windows	thread
	Global Memory	process
	Menus	process
	Classes	process
	Cursors	process
	Icons	process
GDI	Pens	process
	Brushes	process
	Regions	process
	Device Contexts	process
	Fonts	process
	Bitmaps	process
	Palettes	process

Win32 User API Support

- SetDebugErrorLevel
- MessageBoxEx
- ExitWindowsEx
- CopyAcceleratorTable
- CreateAcceleratorTable
- DestroyAcceleratorTable
- EnumPropsEx
- PostThreadMessage
- SendMessageCallback
- SendMessageTimeout
- SendNotifyMessage
- FormatMessage
- AttachThreadInput
- GetThreadDesktop
- CreateIconFromResource
- CreateIconIndirect
- GetIconInfo
- LookupIconIDFromDirectory
- ActivateKeyboardLayout
- GetKeyboardLayoutName
- LoadKeyboardLayout
- UnloadKeyboardLayout
- WindowFromDC
- CreateMDIWindow
- WaitForInputIdle
- MsgWaitForMultipleObjects
- GetForegroundWindow
- SetForegroundWindow

Added User Functionality

- New minimized window look
  - GetSystemMetrics, SM_ARRANGE
- Enhanced control capabilities
  - Bitmap buttons, thumbsize of scroll bars, etc.
- Enhanced support for context-sensitive Help and message boxes

Added User Functionality

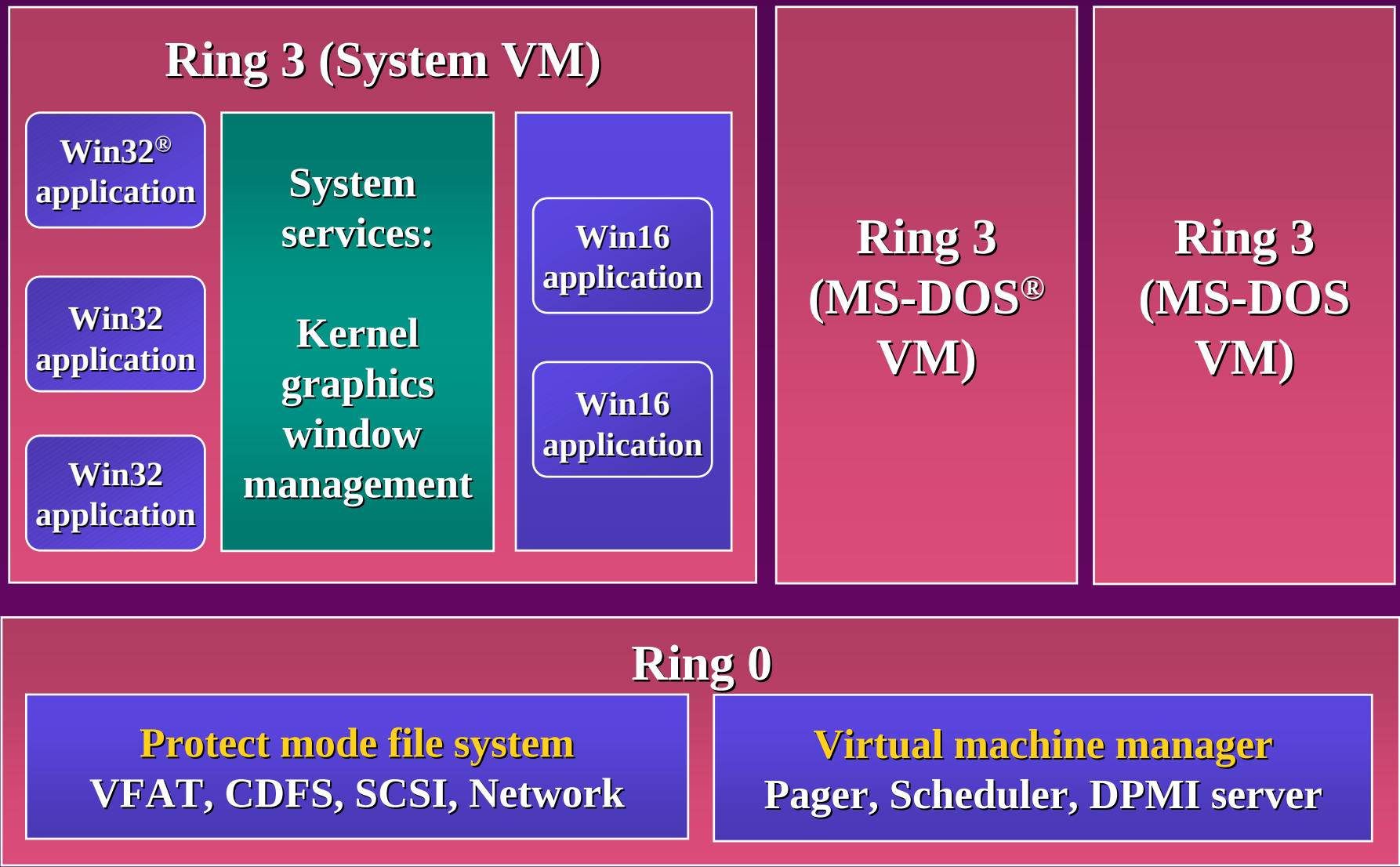
- APIs for drawing 3-D windows and frame controls
- Enhanced menu support (default items, radio items, bitmap/icon items, and extended pop-up menus)
- Dialog manager support for other font styles in RC template

Windows *"Chicago"* Kernel Architecture

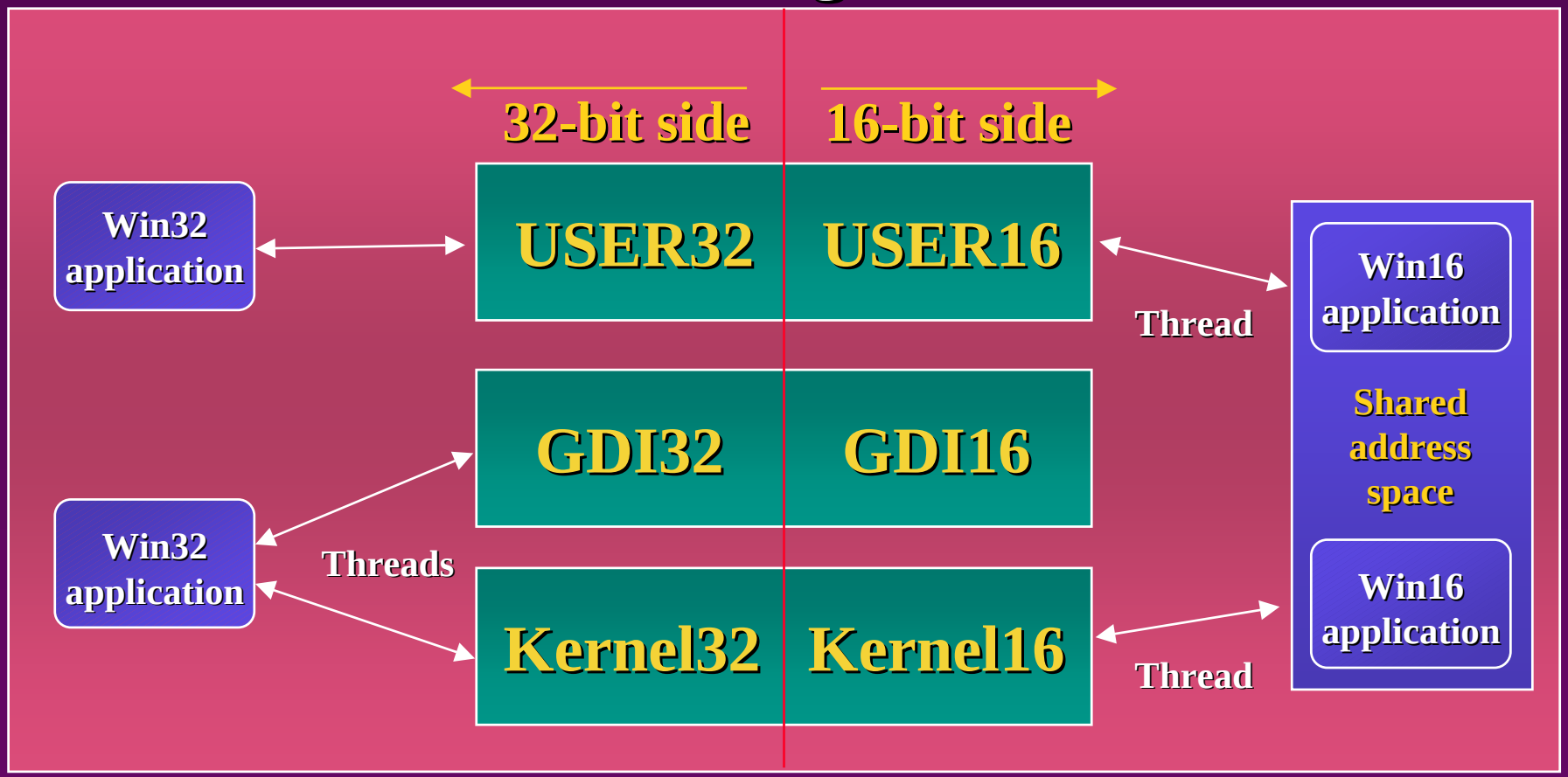
Topics

- “Chicago” system virtual machine overview
- Tasking/scheduling
- API serialization

Windows *"Chicago"* Architecture



System VM Overview



16-Bit Tasking

- Cooperative tasking, same as Microsoft® Windows 3.1
- Each Win16 application runs as a thread, providing for resource tracking in Ring 0 (VxDs) and Ring 3 (GDI and USER)
- Synchronization between applications occurs via messages

32-Bit Tasking

- All 32-bit applications and threads are fully preemptive
- Any thread can call any API
- Fault handler on a separate thread for robustness
- Compatible with Windows NT™ model

The Scheduler

- Compatible with Windows NT model: 32 priority levels supported
- Also compatible with existing Win16 applications, VDDs, and VxDs
- Dynamic priority boosting with timed decay
- Priority inheritance boosting

API Serialization - General

- Every multithreaded OS must serialize some APIs
- Critical sections are commonly used

```
void InsertObjectInList(OBJECT* pobj)
{
    EnterCriticalSection(&Lock);
    pObjectListHead = pobj;
    pobj->pNext = pObjectListHead;
    LeaveCriticalSection(&Lock);
}
```

Serialization Of Windows NT API

- Examples of subsystem serialization:
  - GDI32 uses per-object locking allowing multiple clients to reenter using different objects
  - User32 maintains a single lock for all APIs. Only one thread at a time may be in a User32 API
- Also, applications (clients) and OS subsystems (servers) are on separate processes/threads in Windows NT

Windows *"Chicago"* Win16Lock

- "Chicago" uses a global system-critical section for all Win16 components called the Win16Lock
- When thunking from 32-bit to 16-bit code, "Chicago" always attempts to claim the Win16Lock
- If the current thread cannot own it (because another thread does), it blocks

Results Of Win16Lock

- All 16-bit code is protected, including third-party DLL code
- 16-bit core components stay small and fast
- Compatibility is ensured by not changing API ordering and timing
- Win32 threads calling native 32-bit API do not block on Win16Lock.

Results Of Win16Lock

- Note that any lack of smoothness in multitasking caused by the Win16Lock will only be due to ill-behaved Win16 applications
- A system with only Win32 applications will not be affected by the Win16Lock
- The shell is a Win32 application

Windows *"Chicago"* GDI Architecture

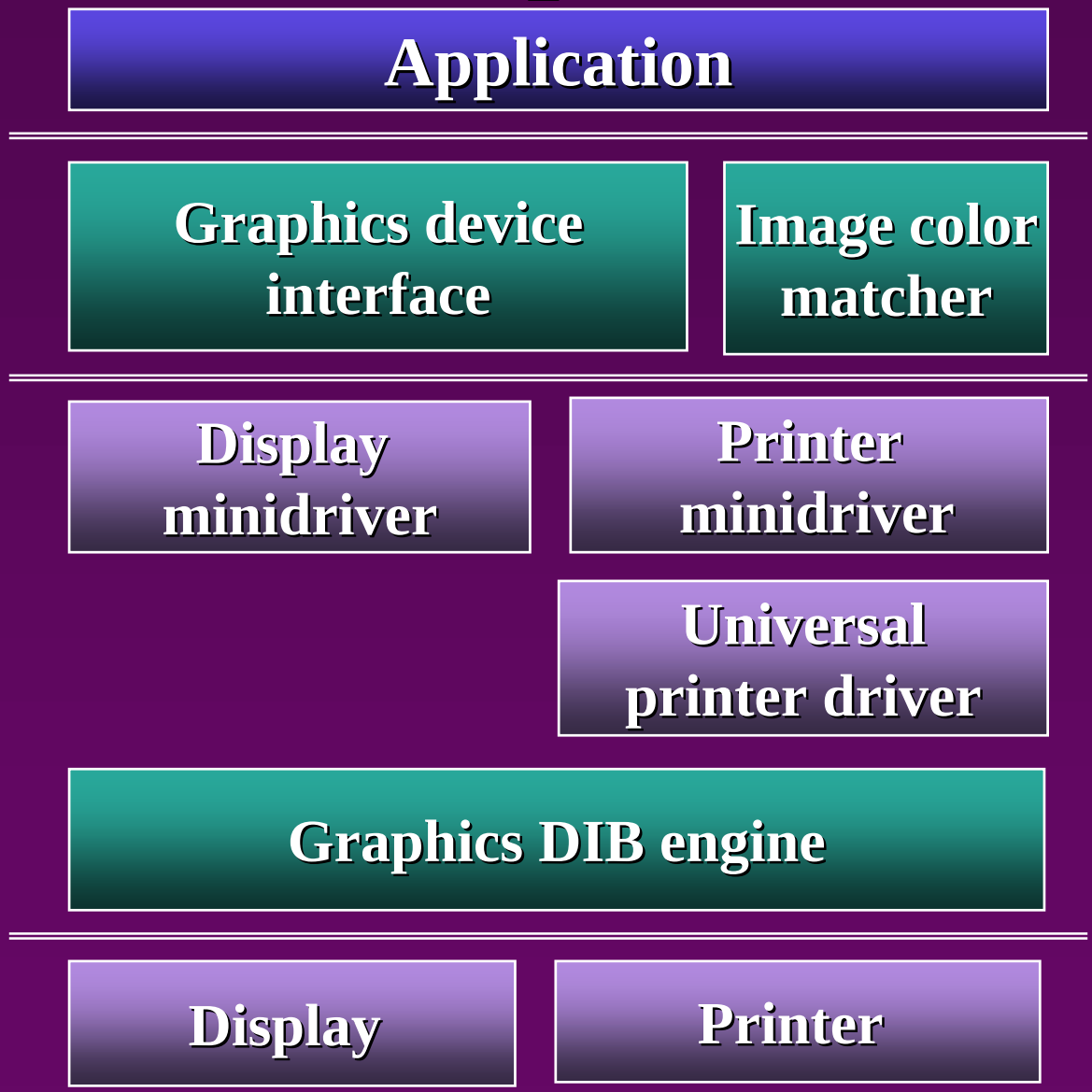
GDI Module Enhancements

- Performance
- Reduce system resource limitations
- Windows NT congruence

Reduce 64K Limitations

- Local heap limitations
  - Regions out
  - Physical objects out
  - Font management structures out
  - DCs still in 64K heap
  - GDI object ownership

Graphics


Application
Graphics device interface
Image color matcher
Display minidriver
Printer minidriver
Universal printer driver
Graphics DIB engine
Display
Printer

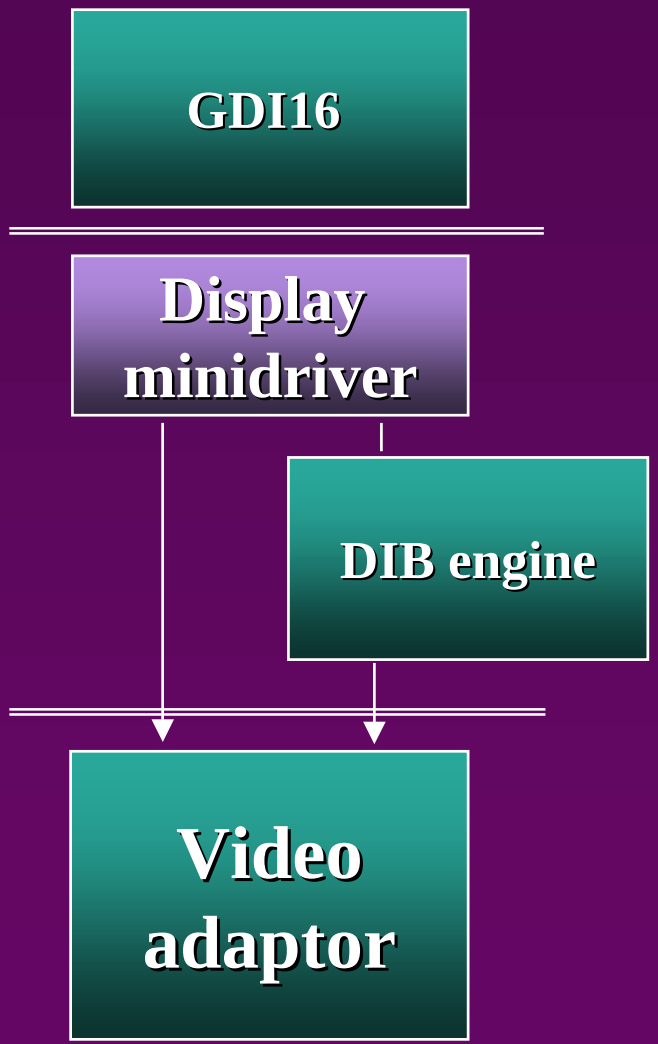
Bitmaps And DIBs

- Windows 3.1 distinction of bitmaps and DIBs
  - Bitmaps - device-dependent
  - DIBs - device-independent
- New DIB APIs
  - CreateDIBSection() - creates a DIB that both applications and GDI can write to
  - SetDIBColorTable()
  - GetDIBColorTable()

32-Bit DIB Engine

- Flat 32-bit code
- Will be the fastest software-only driver
- 1, 4, 8, 16 (555), 24 (RGB) bpp supported
- Straightforward to add other formats

Display Minidrivers



- Works best with:
  - Flat linear frame buffer
  - Local bus video memory
- We will have for “Chicago”
  - The fastest, best driver for frame buffers, with
  - Hooks for hardware accelerators

Advantages Of DIB Engine

- Add new DDI without requiring new drivers
  - Example: WideTextOut
- Printer drivers no longer dependent on quality of display driver
- Very robust display drivers
- Smaller display drivers
- Easy to add new formats

32-Bit TrueType® Rasterizer

- Fixes problems with current rasterizer
- Complicated glyphs, such as Han
- Better fidelity
- Better performance
- Uses memory mapped files
- No more .FOT files
- Faster boot with lots o’ fonts!

Congruence Of Windows NT

- Paths
- Beziers
- Enhanced metafiles
- Color cursors

Paths

- All Win32 path APIs have been implemented
- Primitives: Lineto, Moveto, and PolyBezier supported
- Not pel-perfect to Windows NT

Beziers

- PolyBezier
- PolyBezierTo
- Port of the Windows NT code to 386 assembly
- Not pel-perfect to Windows NT

Metafiles

- Windows 3.1 metafiles “lingua franca”
- Win32 enhanced metafiles
  - All enhanced metafile APIs supported
  - Partial support of world transforms
- Skip records “Chicago” does not understand
- Port of the metafile converter to Windows DLL

Enhanced Metafiles

- Open with reference device
- Goal: reproduce drawing from reference device
- Playback is original size by default
- World transform scales
- Clip regions scale and work, but
- Paths scale better than regions

Additions To Windows NT GDI

Windows NT GDI has but “Chicago” does not

- Wide-styled lines
- Forms
- Transforms
- Dithered pens and text
- Complete 32-bit internals and coordinates
- Masked blit
- Fine-grained reentrancy

Questions?

Windows *"Chicago"* Ring 3 Relative Code Distribution