

MBL331

# 平板电脑软件开发工具集概述

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# 议程

- 平板电脑与Windows® XP平板电脑版
- 平板电脑平台及SDK概述
- 面向对象模型介绍
- 平台控件和组件
- 识别器使用与开发
- 1.7版本平台SDK的新功能
- 平板电脑使用开发资源

# 平板电脑 (Tablet PC)

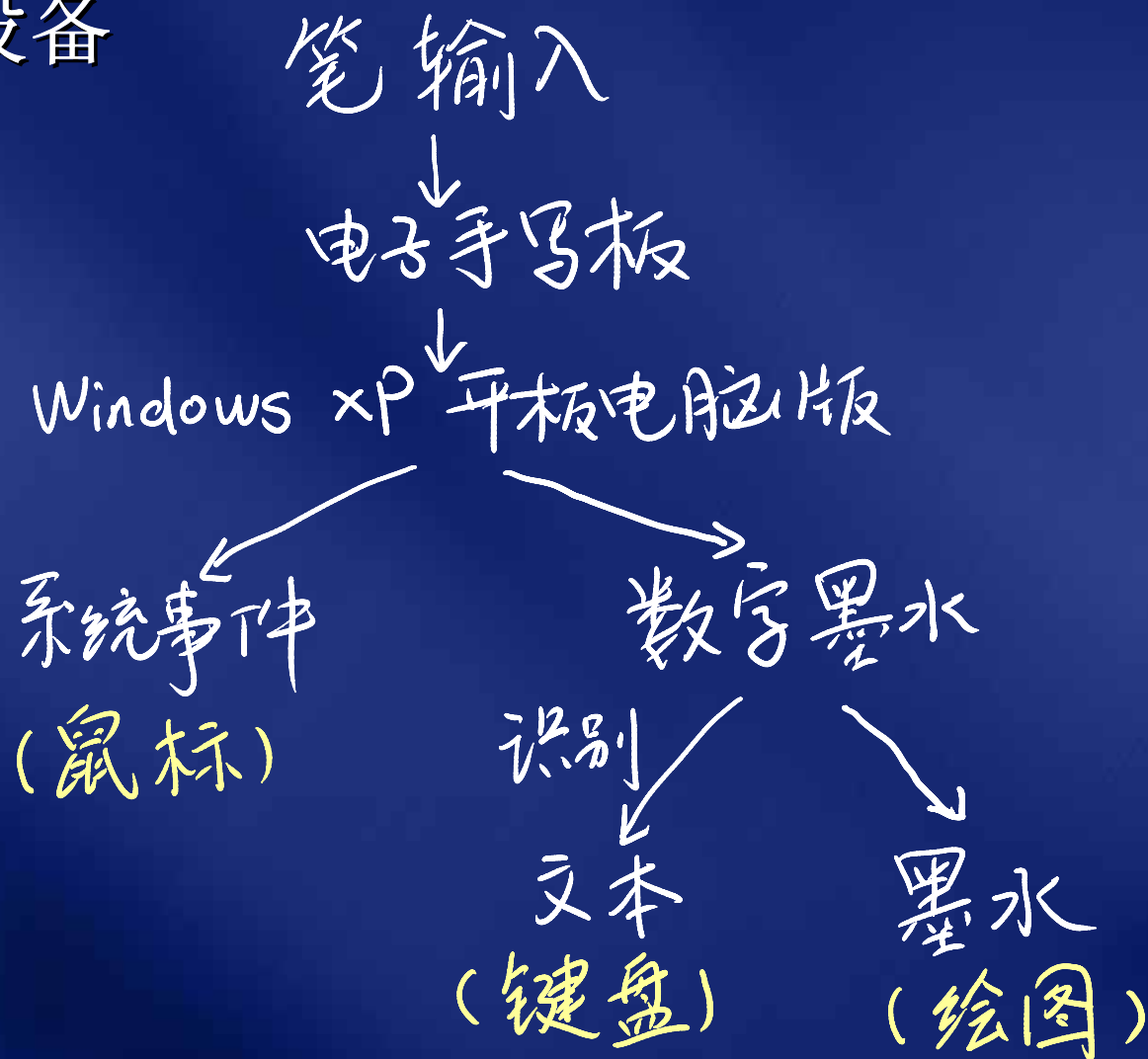
- 笔记本电脑的**进化**
- 先进节能管理, 内置无线网卡, 轻便灵活
- 双用型和纯平板型, 双向显示

## Windows® XP平板电脑版

- Windows® XP专业版 (Pro) 的**扩展**
- 数字笔、墨和语音技术
- 强大的基于笔墨的开发环境

# 平板电脑核心技术

- 笔作为输入设备
- 数字墨水
- 手写体识别





## Vision

Most mobile PCs will be **TVK** enabled within 5 years



FY03

FY05

FY06 and beyond



"Vista"

2005

RTM Aug 2002

RTM H1 2004

RTM 2006

The evolution of the notebook PC

Usability and recognition improvements

The mainstream mobile computer

# 平板电脑平台概述

- 三个主要功能域
  - 数字墨水采集（输入）
  - 数字墨水数据和管理
  - 数字墨水识别
- 数字墨水驱动
  - 数字墨水作为可视对象
  - 数字墨水作为数据类型

# 数字墨水采集 (输入)

- 电子书写板 (digitizer) 基本特点
  - 非常高的数据密度和数据量
  - 数据包特性
    - X, Y
    - 压力, 角度, 旋转度, 等等 ...
- 使用API来采集数字墨水
  - 数字墨水采集器 (InkCollector)
  - 数字墨水覆盖 (InkOverlay)
  - 实时硬笔RealTimeStylus (1.7才有新对象)

# 数字墨水数据和管理

- 数字墨水是一种数据类型
- 多种存放格式
- 数字墨水外形美观
  - 基于向量
  - Bezier平滑变换
  - Anti-aliased
  - 可更改绘制属性
- 丰富，可扩展API
- 复制/剪贴于剪贴板



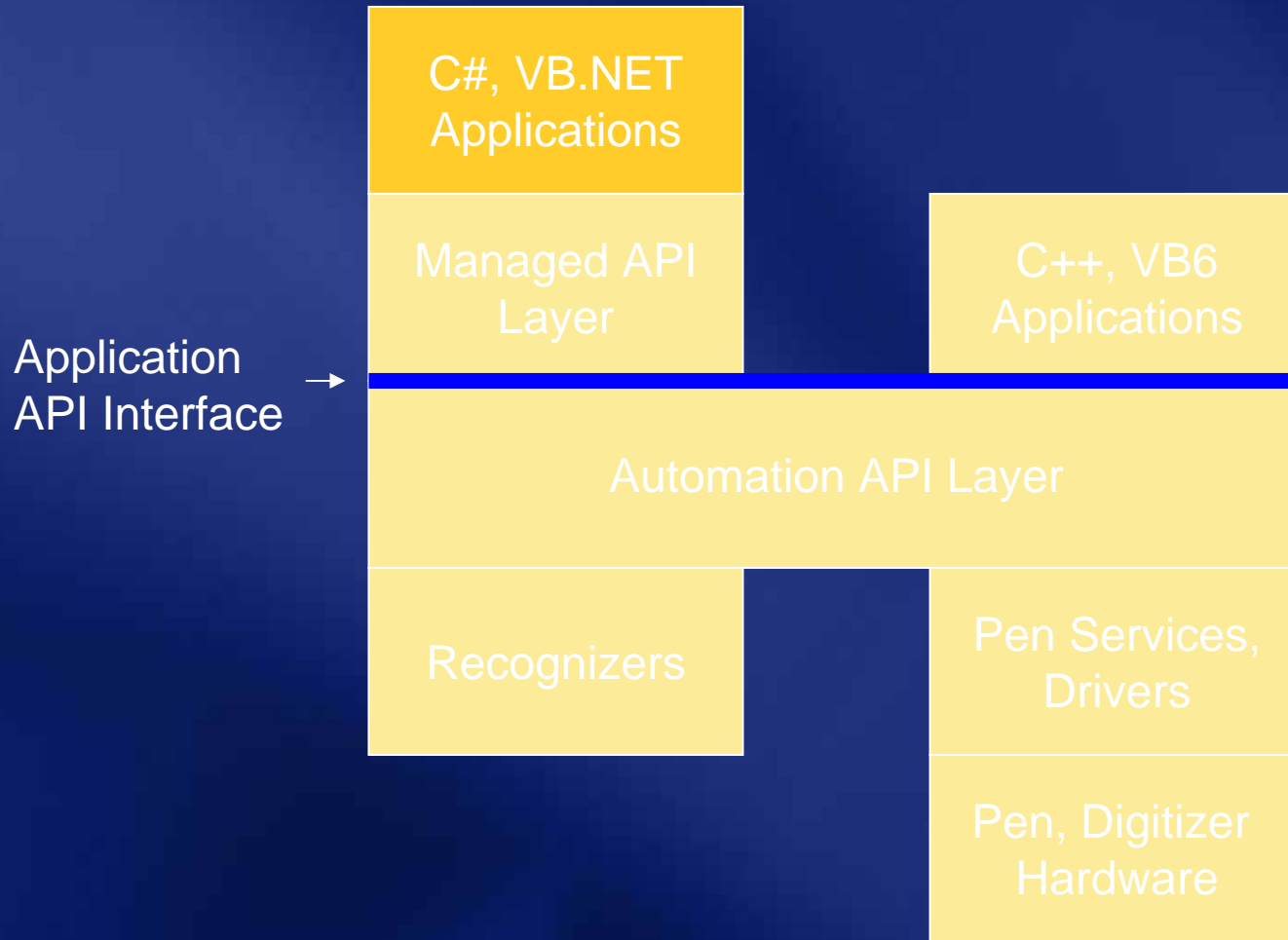
# 数字墨水识别

- 将笔的运动和/或笔划解释成
  - 文字
  - 笔势
  - 图形和符号
- 目前支持的语种
  - 中（简体/繁体），日，朝鲜
  - 英（US / UK ），德，法，意大利，西班牙
- 同步和异步识别
- 识别器构架设计
  - 便利第三方识别器的开发

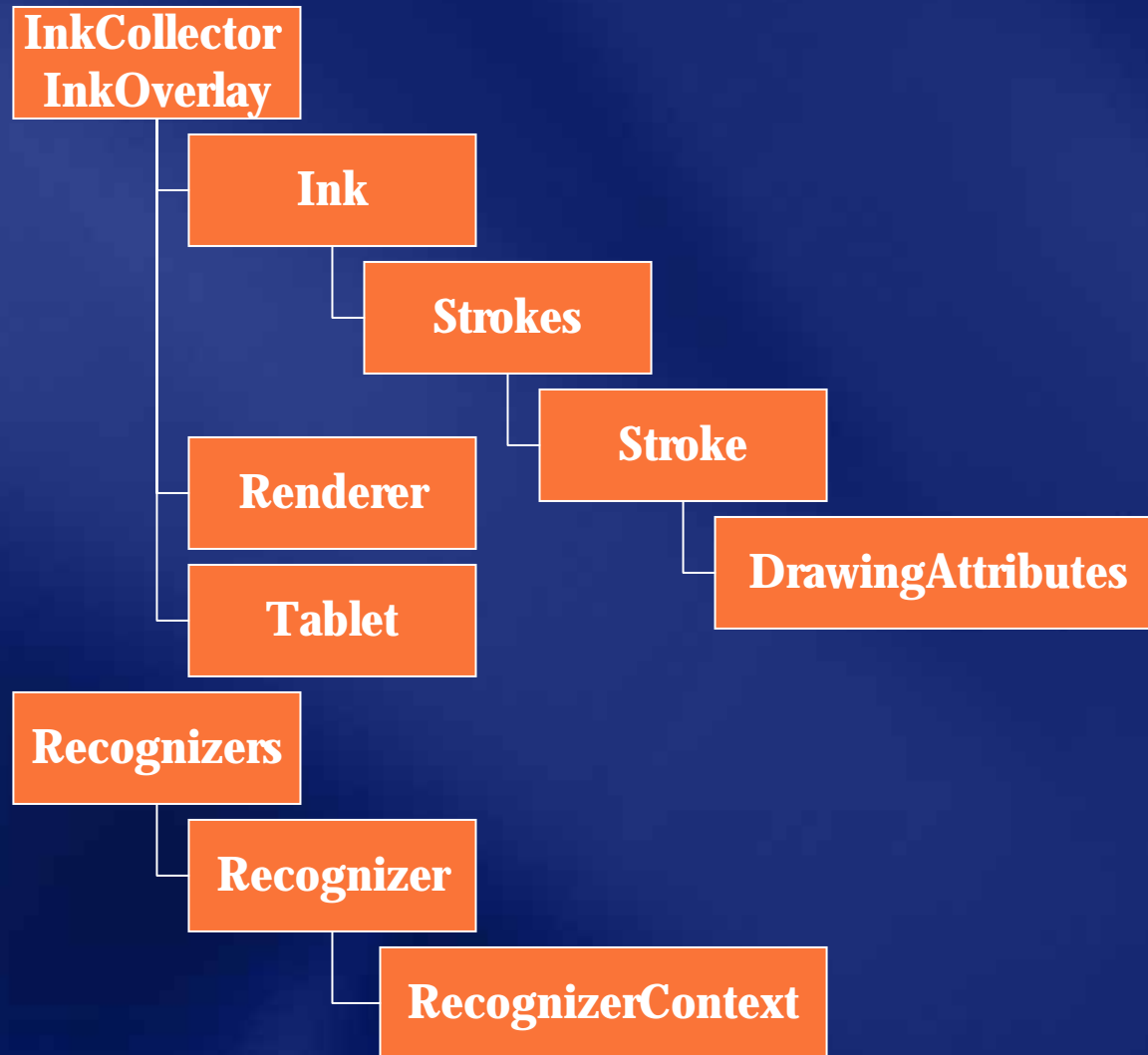
# 平板电脑平台SDK

- 两组APIs
  - Automation (COM) API
    - 双重界面
    - 事件机制基于IDispatch回叫
  - Managed (.NET) API
    - 包在COM API
- 数字墨水控件
  - 数字墨水编辑(InkEdit)
  - 数字墨水图形(InkPicture)
- 帮助文本和范例

# SDK API Overview



# 面向对象模型介绍



# 几个关键对象

- 数字墨水采集
  - 数字墨水采集器 InkCollector
  - 数字墨水覆载 InkOverlay
  - 数字墨水采集事件
- 数字墨水数据管理
  - 数字墨水 Ink
  - 笔划集 Strokes
  - 笔划 Stroke
  - 绘制属性 DrawingAttributes
  - 描绘者 Renderer
  - 数字墨水数据管理事件
- 数字墨水识别
  - 识别器语言环境 RecognizerContext
  - 识别结果 RecognitionResult

# 数字墨水采集对象

# 数字墨水采集器

## InkCollector

- 负责采集数字墨水的最高层对象之一
- 可赋予任意一个视窗句柄(handle)
- 处理所有书写板和鼠标对此句柄的输入
- 载转光标移动情况
- 采集模式属性(CollectionMode)
  - 数字墨水 (InkOnly)
  - 笔势语 (GestureOnly)
  - 数字墨水和笔势语 (InkAndGesture)

# 数字墨水覆载

## InkOverlay

- 数字墨水采集器的扩展
- 编辑模式属性(EditingMode)
  - 采集
  - 删除
  - 选择
- 擦除模式属性(EraserMode)
  - 笔划擦除
  - 点擦除



# 数字墨水采集事件

- 光标进入/离开范围 Cursor (In/OutOf) Range
- 新空中数据包 NewInAirPackets
- 光标按下 CursorDown
- 新数据包 NewPackets
- 笔划 Stroke
- 笔势语 Gesture
- 系统笔势语 SystemGesture
- 鼠标 Mouse

# 数字墨水数据对象

# 数字墨水(Ink)

- 包含
  - 笔划数据
  - 元资料数据
  - 语言环境相关信息
- 控制各种形式的存储
- 可由扩展属性集(ExtendedProperties)扩展

# 笔划 (Stroke)

- 代表一个笔划
  - 包含一次笔按下, 笔移动, 笔抬起的过程中采集的所有数据
- 扩展属性集 (ExtendedProperties) – 允许应用程序添加特有用户数据
- 绘制属性集 (DrawingAttributes) – 控制笔划的描绘
- 丰富API
  - 数据包大小, 数据包包数, 数据包描述
  - Bezier点集, 连续折线波点, 自相交节点

# 笔划集 (Strokes)

- 笔划对象引用的集合
- 包含ICollection, IEnumerable界面的实现
- 将相关笔划组合在一起
  - 用于识别-设置RecognizerContext.Strokes属性
  - 用于转换-元数据

# 绘制者 (Renderer)

- 平板电脑存在两套坐标
  - 设备坐标
  - 数字墨水坐标 (HIMETRIC)
- 绘制者
  - 两套坐标间转换关系
  - 描绘程式
  - 转换程式
    - 支持数据对象和视图之间的转换
    - 帮助程式：缩放，平移，旋转

# 数字墨水数据事件

- 数字墨水加入 (InkAdded) 事件在以下情形发生：
  - 一个笔划对象加入一个数字墨水对象
  - 数字墨水在点擦除模式下有擦除发生
- 数字墨水删除 (InkDeleted) 事件在以下情形发生：
  - 一个笔划对象被从一个数字墨水对象删除
  - 数字墨水在笔划擦除模式下有擦除发生

# 剪贴板的支持

- 使用数字墨水API复制/剪贴
  - ClipboardCopy
  - ClipboardPaste
- 支持多种文本格式
  - ISF-电子墨水存放格式(Ink Serialized Format)
  - 超文本标记语言(HTML)
  - 位图文件(Bitmap), 元文件(Metafile)
- 应用程序可任一上述格式和剪贴板对话

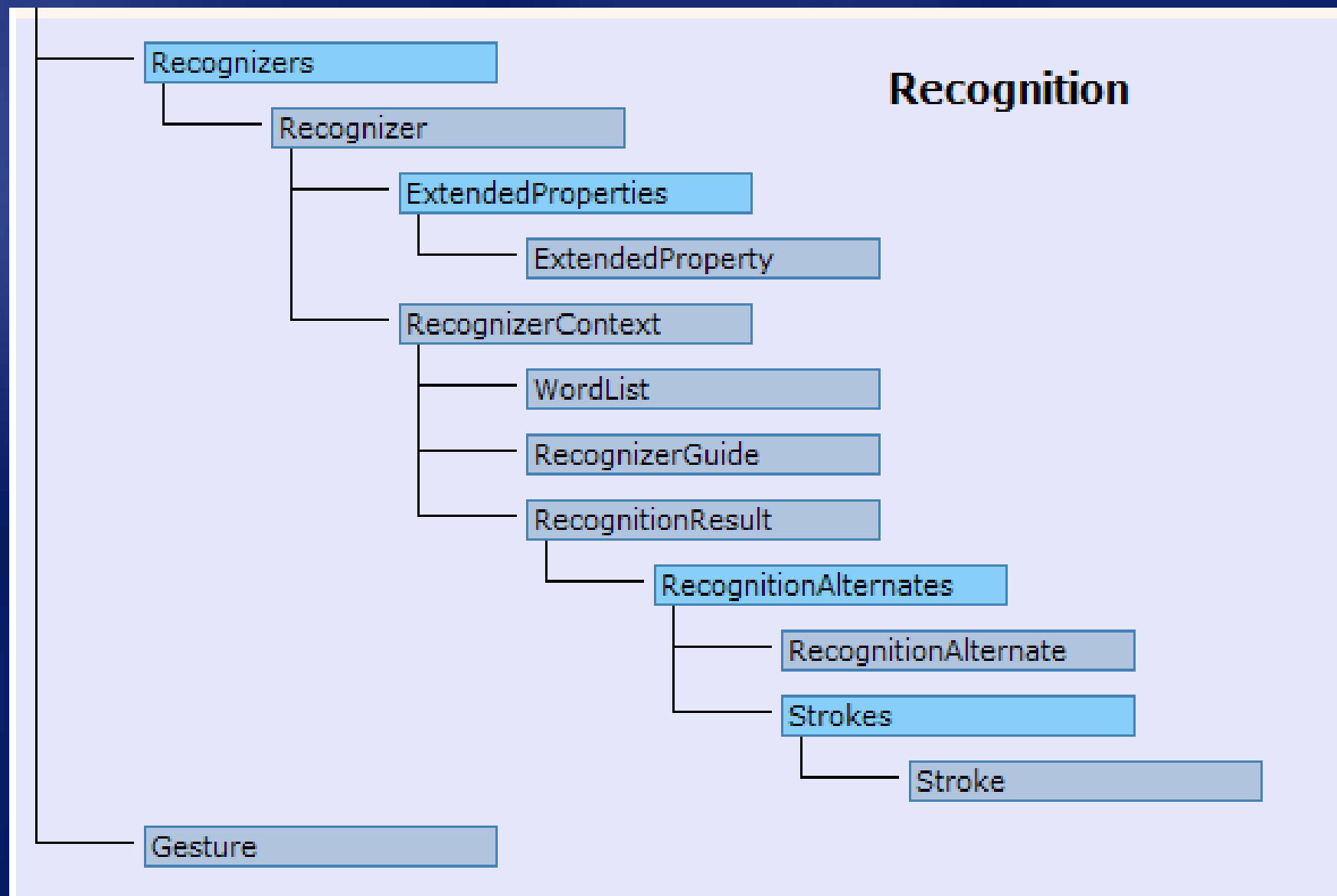


数字墨水采集和处理

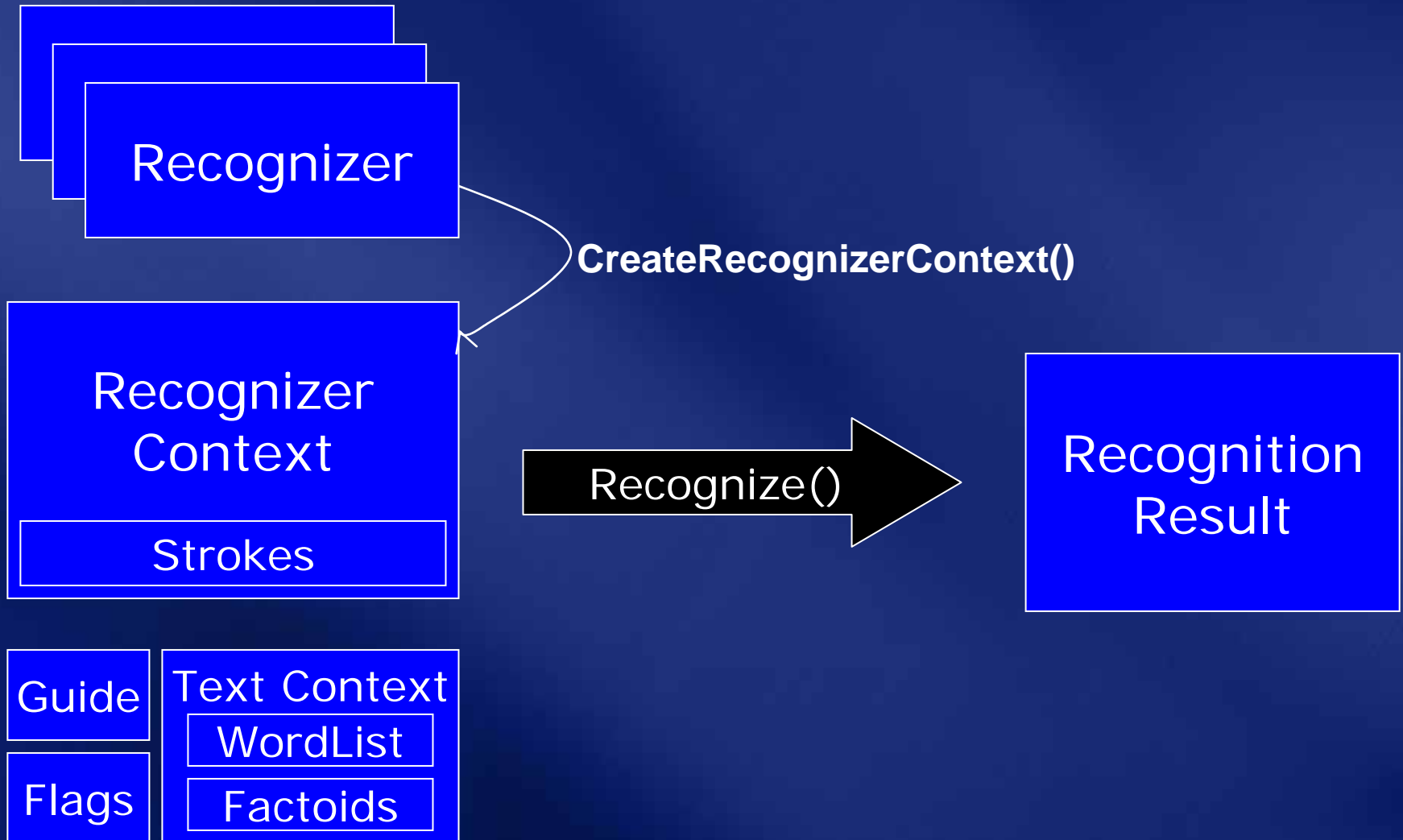
**demo**

# 数字墨水识别对象

# Recognition API Objects



# Recognition Objects



# 识别器Recognizer

- A Recognizer object is a property bag that represents the capabilities of a given handwriting recognizer
- Most calls are quick registry lookups
- The Recognizer object is used to create a RecognizerContext (which does the actual work)

# 识别器语言环境

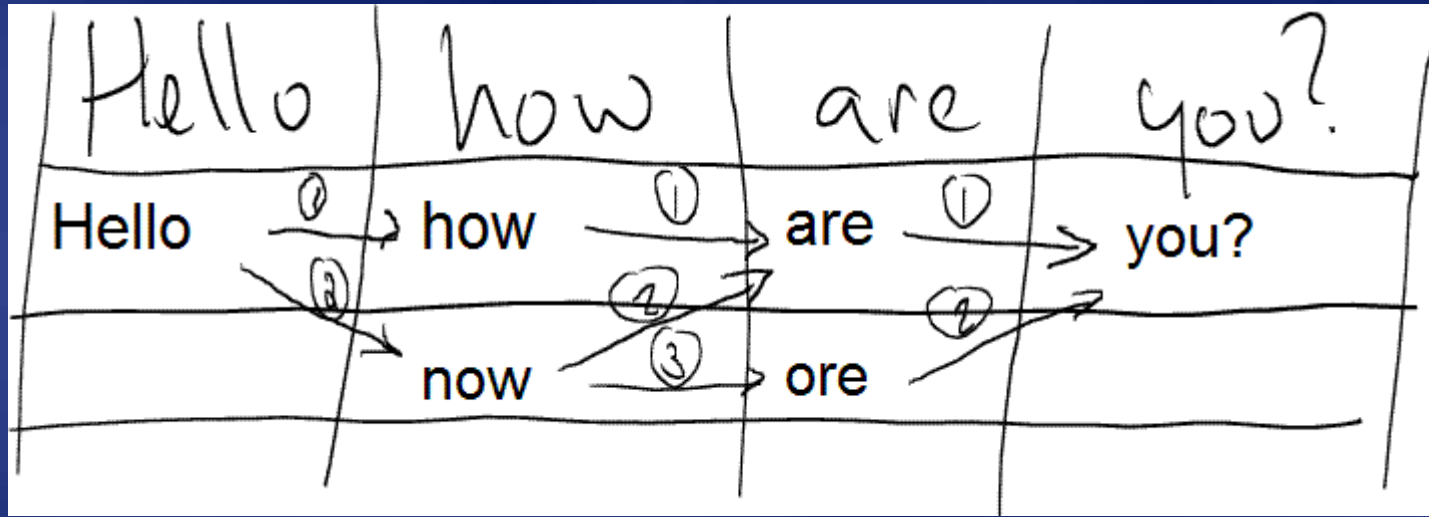
RecognizerContext

- 赋予识别器一个特定的语言环境
  - Guide
  - Factoid
- 支持识别一组笔划
  - 同步（前台）识别
  - 异步（后台）识别
    - 包含以下事件
      - 识别
      - 带选择的识别
- 提供识别结果和候选结果

# 识别结果 (RecognitionResult)

- 识别器返回一套数据结构
  - 每个结构是一个格子 “lattice”
  - 格子完整复制给识别结果和其它对象
- 顶端字符串 (TopString) 属性
- 包含于笔划集并被加入成为数字墨水的用户笔划属性 (Ink.CustomStrokes)
  - SetResultOnStrokes 程式
- 识别候选集 (RecognitionAlternates)
  - GetAlternatesFromSelection 程式
  - 提供候选 (不同) 格子的路径

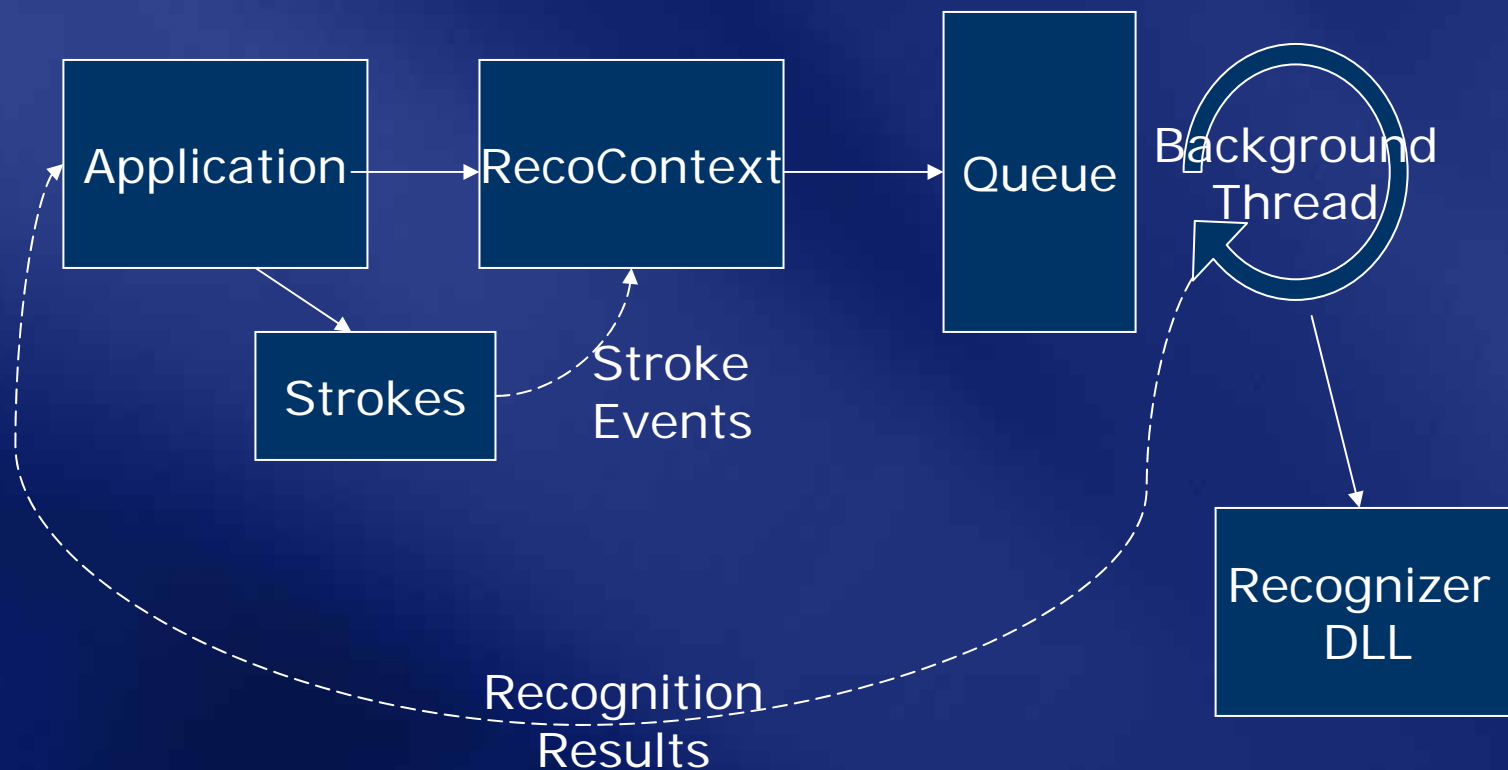
# RecognitionResult Structure



- Paths of one or more segment through the result's lattice are called RecognitionAlternates
- Each RecognitionAlternate contains information that relates to the related strokes for the contained segments
  - Strokes, Line, Confidence, Text, etc...
- The best path through the lattice determines how the strokes relate to the text
  - GetAlternatesFromSelection uses this text



# Overview of Internal Recognition Architecture



数字墨水识别

demo

# 平台控件和组件

# 平台控件

- 数字墨水编辑 (InkEdit)
  - 象文本编辑一样处理数字墨水
  - 用于文本和数字墨水至文本场合
  - 适用于聪明表格
  - 覆盖RichEdit控件
  - Win32, .NET, ActiveX版本
- 数字墨水图形 (InkPicture)
  - 将数字墨水附加于图像上  
(.jpg, .bmp, .png, .gif)
  - 采集和存放数字墨水(没有损失)
  - 覆盖PictureBox控件, 和InkOverlay相近
  - .NET and ActiveX版本

# 平台组件

- 笔输入板 (PenInputPanel)
  - PIP提供编程支持 (v 1.5)
    - 可联通于任意视窗句柄或控件
  - TIP的基本控件 (Lonestar)
    - 启用 / 停止使用, 等等.
    - 应向前兼容性要求
- 划分者 (InkDivider)
  - 把数字墨水划分成字词, 行, 段落和图形
  - 转换有倾角的数字墨水

数字墨水划分和划分者组件

**demo**

# 1.7平台中的新功能

# 语言环境

- 什么是语言环境?
  - 您提供给识别程序的应用程序特有的信息
    - 限制识别的规则和可能性
    - 极大提高识别准确率
- 语言环境信息的例子
  - Factoids: `recoContext.Factoid = "(!IS_DATE)";`
  - 字词表
  - 常规表达(regular expressions)的客户输入范围
- Lonestar中使用语言环境的程序
  - Internet Explorer (Address Bar)
  - Outlook 2003 (To:, Cc:, Bcc:)



# 无数字墨水支持控件的语言环境支持

- SetInputScope API (新的 WIN32 API)
  - 低层次编程解决方法
  - 需要重编译执行码
  - 已经有 .NET开发的白皮书
- 语言环境标签工具
  - 无编程需要
  - 无须改变现有执行码
  - 能将输入范围/区域关系连同XML宣示存储

# 硬笔输入APIs

- 直接接触电子书写板数据流
  - 实时处理数据包数据
  - 隔离实时采集和用户输入线程
  - 得到比InkOverlay, InkEdit更好的效率, 等等.
- 制作客户组件
  - 实时数字墨水组件
    - 客户动态描绘 (比如说, 利用硬件加速)
    - 客户笔势语识别
    - 特定范围暂停(WindowInputRectangle属性)
  - 数字墨水采集组件
    - 客户InkOverlay或InkCollector组件

# 其它改进

- 数字墨水的处理
  - 用完整数据包描述来产生笔划
- HTTP用户代理
  - 现在确认平板电脑OS和SDK版本
- 改进SDK帮助文本
  - 许多新内容， 范例， 等等...

# 语言环境标签工具

# demo

# 开发环境

- 在非平板电脑上的安装
  - 在Win2K SP3以上OS可装SDK
  - 在非平板电脑硬件上装WinXP Tablet PC Edition OS
  - Microsoft Virtual PC
  - 可从MSDN下载
    - MSDN: SDK
    - MSDN订户下载: OS
- 模拟电子书写板
  - 外接HID电子书写板
  - 鼠标 (UseMouseForInput属性)

# 发布您的平板电脑应用程序

- 再分发模块
- 注意事项
  - 识别
  - 带/不带电子书写板的数字墨水采集
  - PIP和TIP
  - 不支持Win9X平台

# 平板电脑使用及开发资源

- <http://www.microsoft.com/windowsxp/tabletpc/default.mspx>
- <http://msdn.microsoft.com/mobility/tabletpc/default.aspx>
- <http://www.tabletpcpartners.com>
- [\*Building Tablet PC Applications\*](#) by Rob Jarrett and Philip Su, Microsoft Press

# Tablet PC Developer Center

- The latest technical articles
- Downloads
- Developer resources
- Regular columns
- Newsgroups
- Featured partners
- and more.....

mobile **ink jots**





# Community Resources

Attend a free chat or web cast

<http://www.microsoft.com/communities/chats/default.mspx>

<http://www.microsoft.com/usa/webcasts/default.asp>

List of newsgroups

<http://communities2.microsoft.com/communities/newsgroups/en-us/default.aspx>

MS Community Sites

<http://www.microsoft.com/communities/default.mspx>

Locate Local User Groups

<http://www.microsoft.com/communities/usergroups/default.mspx>

Community sites

<http://www.microsoft.com/communities/related/default.mspx>

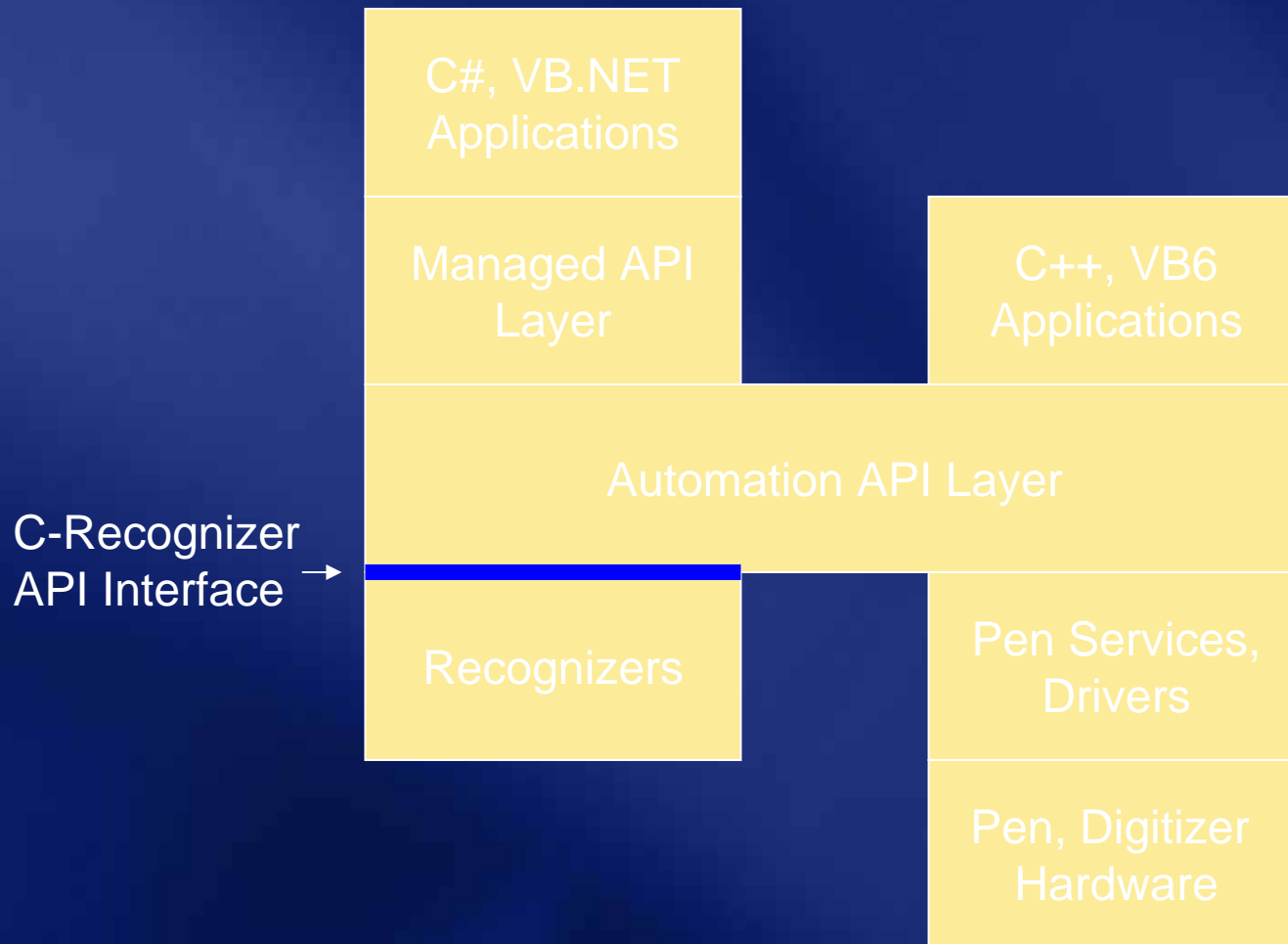
# Appendix

- If time permits, I'll present the following material:
  - How to develop your own recognizer and port it to Tablet PC Platform

# TabletPC Handwriting Recognizers

- Recognition API on Recognizers

# Platform Overview



*MS Buzzwords: Automation API, Managed API*

# Recognizer API

- C API
- Simple API for implementing a recognizer
- Automation / Managed layers provide a friendly API to application programmers – recognizer authors don't have to deal with that.

# Objects in API

- Recognizer
- RecoContext
- Lattice
- WordList



Not needed for  
Automation / Managed  
Layers

# Pseudo-Code Calling Sequence

1. `hrec = CreateRecognizer()`
2. `hrc = CreateContext(hrec)`
3. `AddStroke(hrc, ink)`
4. `EndInkInput(hrc)`
5. `ptr = GetLatticePtr(hrc)`
6. `DestroyContext(hrc)`
7. `DestroyRecognizer(hrec)`

# Recognizer Object

This object represents the recognizer for a particular language.

- HRESULT CreateRecognizer(CLSID \*pCLSID, HRECOGNIZER \*phrec)
  - Create an instance of a recognizer specified by a CLSID
- HRESULT DestroyRecognizer(HRECOGNIZER hrec)
  - Destroy instance of recognizer
- HRESULT GetRecoAttributes(HRECOGNIZER hrec, RECO\_ATTRS \*pRecoAttrs)
  - Get information about the recognizer: friendly name, vendor name, languages and modes supported
- HRESULT GetResultPropertyList(HRECOGNIZER hrec, ULONG \*pPropertyCount, GUID \*pPropertyGuid);
  - Get a list of properties (identified by GUIDs) associated with results
- HRESULT GetPreferredPacketDescription(HRECOGNIZER hrec, PACKET\_DESCRIPTION \*pPacketDescription);
  - Get a description of the ink format used by the recognizer
- HRESULT GetUnicodeRanges(HRECOGNIZER hrec, ULONG \*pcRanges, CHARACTER\_RANGE \*pcr);
  - Returns a list of all supported Unicode characters



# Registry Settings

HKEY\_LOCAL\_MACHINE\SOFTWARE\  
Microsoft\TPG\Recognizers\CLSID:

- Recognizer Capability Flags
  - Supported modes as returned by GetRecoAttributes
- Recognizer dll
  - Path to the DLL file
- Recognized Languages
  - Supported languages (LCIDs) as returned by GetRecoAttributes

# RecoContext Object

All recognition of ink is done in a RecoContext object.

- HRESULT CreateContext(HRECOGNIZER hrec,  
HRECOCONTEXT \*phrc)
  - Create a context for holding recognition settings
- HRESULT DestroyContext(HRECOCONTEXT hrc)
  - Clean up after a recognition session
- HRESULT CloneContext(HRECOCONTEXT hrc,  
HRECOCONTEXT \*pCloneHrc)
  - Make a copy of the recognition context. All settings are preserved, but ink and results are discarded.
- HRESULT ResetContext(HRECOCONTEXT hrc)
  - Discard ink and results from current context, but keep all settings

# RecoContext Settings

- HRESULT SetGuide(HRECOCONTEXT hrc, const RECO\_GUIDE \*pGuide, ULONG iIndex)
  - Gives recognizer segmentation hints with either a lined or boxed writing guide
- HRESULT SetCACMode(HRECOCONTEXT hrc, int iMode)
  - For EA recognizers, tells the recognizer whether the input is a partial or complete character
- HRESULT SetFactoid(HRECOCONTEXT hrc, ULONG cwcFactoid, const WCHAR \*pwcFactoid)
  - Constrains input to be DATE, TIME, DIGIT, etc.
- HRESULT SetWordList(HRECOCONTEXT hrc, HRECOWORDLIST hwl)
  - Sets a list of words, which together with setting the WORDLIST factoid, constrains recognition
- HRESULT SetFlags(HRECOCONTEXT hrc, DWORD dwFlags)
  - Segment ink into words? Return multiple segmentations? Enforce factoid strictly?
- HRESULT SetTextContext(HRECOCONTEXT hrc, ULONG cwcBefore, WCHAR \*pwcBefore, ULONG cwcAfter, WCHAR \*pwcAfter)
  - Provides context to recognizer about what characters are before and after the ink being recognized

# RecoContext Input

- HRESULT AddStroke(HRECOCONTEXT hrc,  
    PACKET\_DESCRIPTION \*pPacketDesc,  
    ULONG cbPacket, const BYTE \*pPacket,  
    XFORM \*pXForm)
  - Add ink to context
  - Format of data controlled by packet description
  - Ink is given in digitizer coordinates, given transform maps to “ink space”
- HRESULT EndInkInput(HRECOCONTEXT hrc)
  - Tells the recognizer that writing is finished

# RecoContext Processing

- HRESULT AdviseInkChange(HRECOCONTEXT hrc,  
    BOOL bNewStroke)
  - Can be called from another thread to interrupt current work
- HRESULT Process(HRECOCONTEXT hrc,  
    BOOL \*pbPartialProcessing)
  - Do some processing on the ink so far
- HRESULT GetLatticePtr(HRECOCONTEXT hrc,  
    RECO\_LATTICE \*\*ppLattice)
  - Get the result lattice. More on this later.

# WordList Object

Word lists are used to implement custom dictionaries. These functions are optional.

- HRESULT MakeWordList(HRECOGNIZER hrec,  
WCHAR \*pBuffer, HRECOWORDLIST \*phwl)
  - Create a word list from a list of words
- HRESULT DestroyWordList(HRECOWORDLIST hwl)
  - Destroy the wordlist
- HRESULT AddWordsToWordList(HRECOWORDLIST hwl,  
WCHAR \*pwcWords)
  - Add some words to the word list

# Lattice Structure

- HRESULT GetLatticePtr(  
    HRECOCONTEXT hrc,  
    RECO\_LATTICE \*\*ppLattice)
- Used to return all results
- RECO\_LATTICE contains:
  - RECO\_LATTICE\_COLUMNS and column count
  - List of result property identifiers that may be present
  - Pointers to best result

# RECO\_LATTICE\_COLUMN

## RECO\_LATTICE\_ELEMENT

- Each column contains:
  - Array of RECO\_LATTICE\_ELEMENTS
  - Array of strokes used by this column
  - Array of properties and values applying to all elements in the column
- Each element contains:
  - Score (0 is best, higher values worse)
  - String
  - Number of strokes from column used by this element
  - Pointer to next column
  - Array of properties and values for this element only



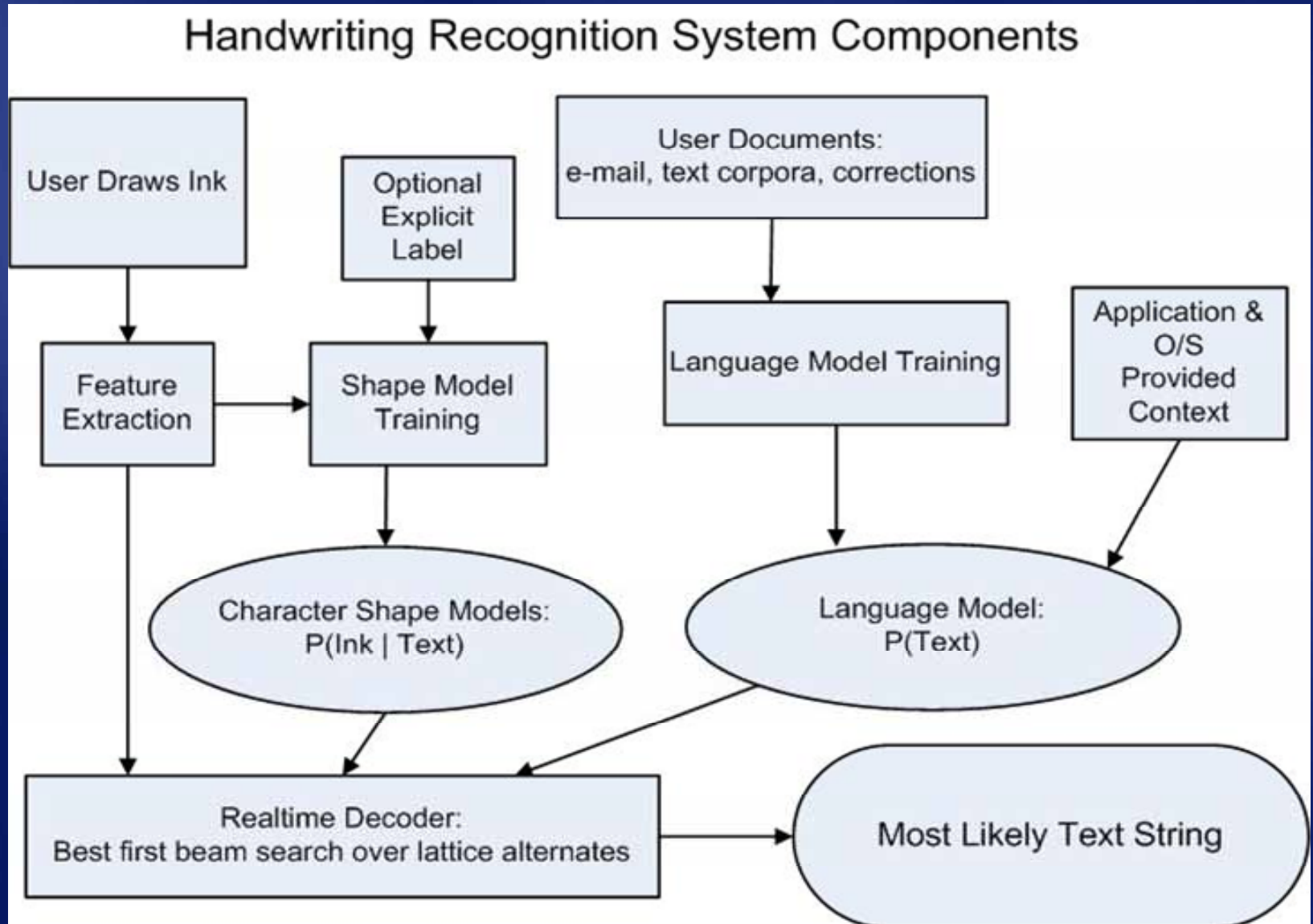
# RECO\_LATTICE\_PROPERTIES

- RECO\_LATTICE\_PROPERTIES:
  - Count of properties and values
  - Array of RECO\_LATTICE\_PROPERTY
- RECO\_LATTICE\_PROPERTY:
  - Property identifier GUID
  - Array of bytes containing the value

# A Few Standard Properties

- CONFIDENCE\_LEVEL
  - High, Medium, or Low
- LINE\_NUMBER
  - Line of text this word is on
- LINE\_METRICS
  - Location of the baseline or midline
- You can define your own

# Reco Architecture Overview



Questions?

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