

The Past and Future of Pen Computing

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Technology has become the international language of progress, of building things rather than destroying them

PC Market: Cloudy Future

- After 20 years of growth, demand leveling off
- IDC and Dataquest say shipments down first time ever
- Still 30 million in Q2/2001, but....
 - Commodity components make it difficult to make profit
 - PC prices have come down:
 - 1981: 4.77MHz PC costs US\$4,000 (\$7,767 in 2001 money)
 - 2001: 1.8GHz PC costs US\$1,000
- Notebook market a bit better
- Estimate: 26 million units for 2001, same as for 2000

It is clear that PCs and notebooks as we know them represent the past and the present of computing, but not necessarily the future of computing.

Many people agree that PDAs and pen tablets or web tablets are a technology with a very promising future.

PDA Projections (1)

- IDC said that Asia Pacific (without Japan) PDA sales were about two million in 2000.
- Dataquest said there were 2.1 million PDAs sold in Europe in 2000, with Palm and Pocket PC each having a marketshare of about 40%.
- The US PDA market is 7-8 million units this year, and represents 60-70% of worldwide PDA sales right now.
- Microsoft said in May 2001 that 1.25 million Pocket PCs have sold since the April 2000 introduction. At a recent Microsoft conference in Seattle, Washington, Microsoft said that two million Pocket PCs have been sold worldwide.

PDA Projections (2)

- One report said there was a backlog of five million iPAQ Pocket PCs.
- Palm says that as of June 2001, over 16 million Palm devices have been sold.
- Dataquest says that global PDA sales will be about 14 million units this year and may reach 33 million in 2004.
- Aberdeen expects overall handheld sales to grow by 30 percent a year through 2005, bringing total sales to 39 million units.
- Strategic Analytics predicts 85 million units by 2006.

What about Tablet PCs and WebPADs?

- Tablet PC

- Introduced Comdex 2000
- Demos Comdex 2001
- Full notebook functionality
- Windows XP + pen/voice overlay
- Compaq, FIC, Toshiba, Fujitsu, Acer, Wistron

- WebPADs

- Pioneered by National Semiconductor
- Not a computer
- Base, cradle, tablet
- E-Lab, FrontPath, View-Tech, AboCom, Honeywell, Hitachi, Palmax, RSC, Philips, FIC, etc.

Tablet PC chance of success

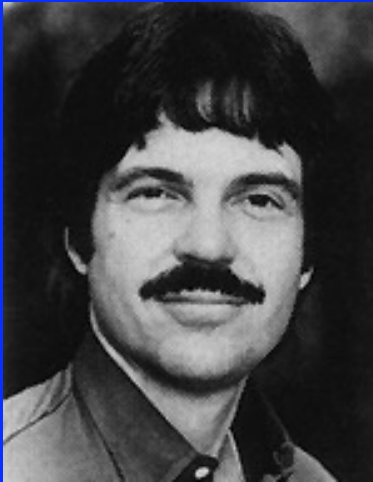
- Informal estimates:
 - 2003: 2-4% of all notebooks might be Tablet PC
 - Microsoft: As many as a million Tablet PCs in 2003
 - 2005: 50% of 50 million notebooks will use Windows XP Tablet PC Edition
 - Even if only one in five is a tablet, that is 5 million pen tablets.
- Pen Computing Magazine estimate:
 - 50% chance that first generation succeeds (June 2001)
 - 20% chance that first generation succeeds (Sept. 2001)

To build the future,
we must learn from
the past

History of pen computing

- **1914:** Goldberg gets US patent for recognition of handwritten numbers to control machines
- **1938:** Hansel gets US patent for machine recognition of handwriting
- **1956:** RAND Corporation develops digitizing tablet for handwriting recognition
- **1957-62:** Handwriting recognition projects with accuracies of 97-99%
- **1963:** Bell Labs develops cursive recognizer
- **1966:** RAND creates GRAIL, similar to Graffiti

Pioneer: Alan Kay



- Utah State University
- Stanford University
- Xerox PARC: GUI, SmallTalk, OOL
- Apple Computer Research Fellow
- Disney
- Envisioned Dynabook in 1968:

The Dynabook will be a “dynamic medium for creative thought, capable of synthesizing all media – pictures, animation, sound, and text – through the intimacy and responsiveness of the personal computer.”

History of pen computing

- **1970s:** Commercial products, including kana/romanji billing machine
- **1980s:** Handwriting recognition companies
 - Nestor
 - Communication Intelligence Corporation
 - Lexicus
 - Several others

Pioneers: Apple



- 1987 Apple prototype
 - Speech recognition
 - Intelligent agents
 - Camera
 - Folding display
 - Video conferencing
 - Wireless communication
 - Personal Information Manager

“Knowledge Navigator”



In 1987, Apple Computer developed the Knowledge Navigator. It added speech recognition, audio, video, and intelligent information retrieval to the “Dynabook” concept.

Pen Computing Hype

- **1991:** Hype is building!
 - Pen as the next interface
 - Pen may replace keyboard
 - GRiD builds pen computer that runs PenDOS
 - GO Corporation finalizes PenPoint
 - EO founded to build PenPoint pen computers
 - But more power needed to run PenPoint and PenWindows

Pen Computing Hype

“The impact of pens on computing will be far greater than the mouse. The two key benefits—extreme portability and ease of use—will enable tiny, low-cost PCs that will appeal to a broader spectrum of users than ever before. Imagine “smart paper” that can do everything paper can as well as recognize objects, do calculations, neatly organize, duplicate and transmit itself.”

Greg Slyngstad, General Manager

Microsoft Pen Computing Group, November 1991

Pen Computing Hype

- **1992:** Products arrive
 - GO releases PenPoint in the spring of 92
 - Truly pen-centric
 - But steep learning curve
 - Lexicus Longhand handwriting recognition
 - Microsoft releases Windows for Pen Computing
 - Layer on top of Windows
 - But runs all existing Windows applications
 - Momenta creates its own Interface

1st Wave of Pen Tablets

- **1992-1994**
- 386 or 486 processor
- 4-8MB of RAM
- Windows for Pen Computing/PenPoint
- PC Card slots
- Clipboard format
- 3 to 4.5 pounds
- Active digitizer (Wacom or Kurta/Mutoh)
- 6 to 8-inch monochrome LCDs

Early Pen Computers: Momenta



- Founded 1989 by Iranian Kamran Elahian
- Introduced October 1991
- 386/20, advanced design
- US\$40 million in VC capital
- Failed and closed in 1992

Early Pen Computers

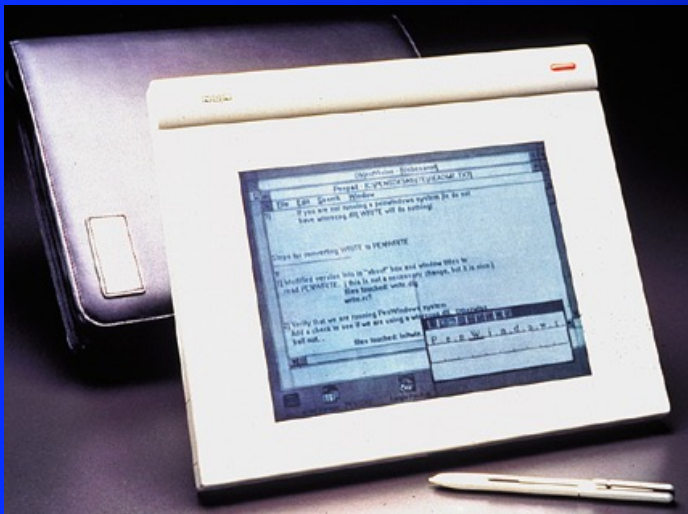
AT&T EO 440



- November 1992
- PenPoint OS
- Excellent product
- Larger 880 model had cellphone option
- Sold by Dell for a while
- AT&T stopped production and closed GO/EO in 94
- US\$70 million VC money lost

Early Pen Computers

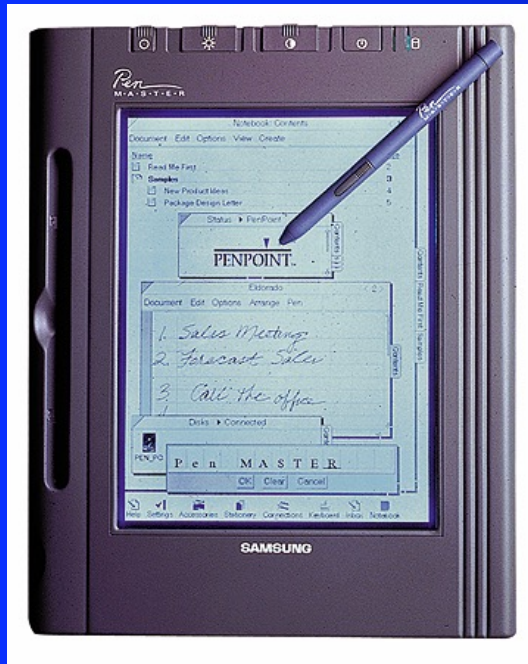
NCR NotePad 3125



- Late 1992
- First pen tablet to run Pen Windows or PenPoint
- Weighed just over 4 pounds
- Four hour battery
- 3130 model adds backlight

Early Pen Computers

Samsung PenMaster

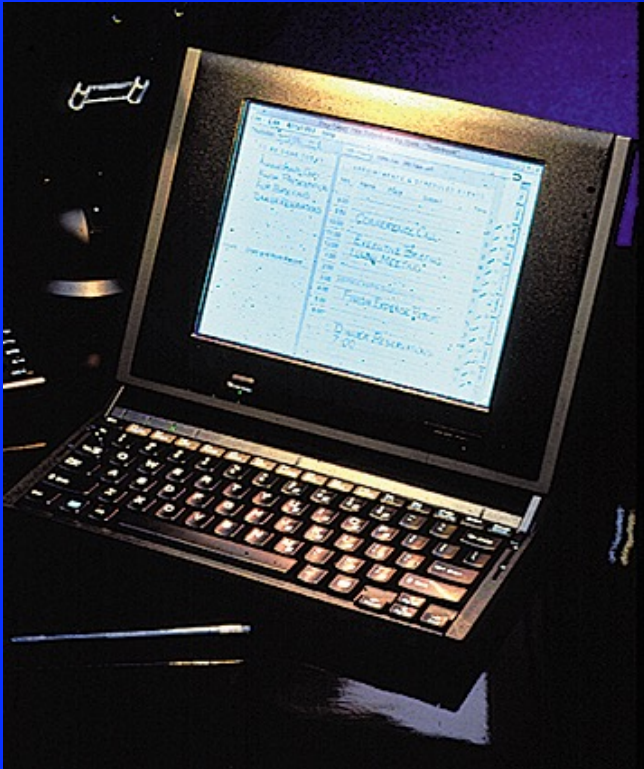


- Late 1992
- Also sold as GRiDPad SL
- Intel 386/16, backlight
- PenPoint or PenWindows
- Wacom digitizer, edged screen
- 2 PC Card slots
- Great design!

Early Pen Computers

GRiD

Jeff Hawkins designed the GRiD
Convertible, GRiDPAD, GRiD PalmPad



Early Pen Computers

Dauphin DTR-1



- 1992/93
- “Desk Top Replacement”
- Intel 486SLC/25
- PenWindows
- 2.5 pounds
- Sold in computer chains
- Later more powerful DTR-2 and Orasis
- Lost US\$50 million, bankrupt (restructured now)

Early Pen Computers

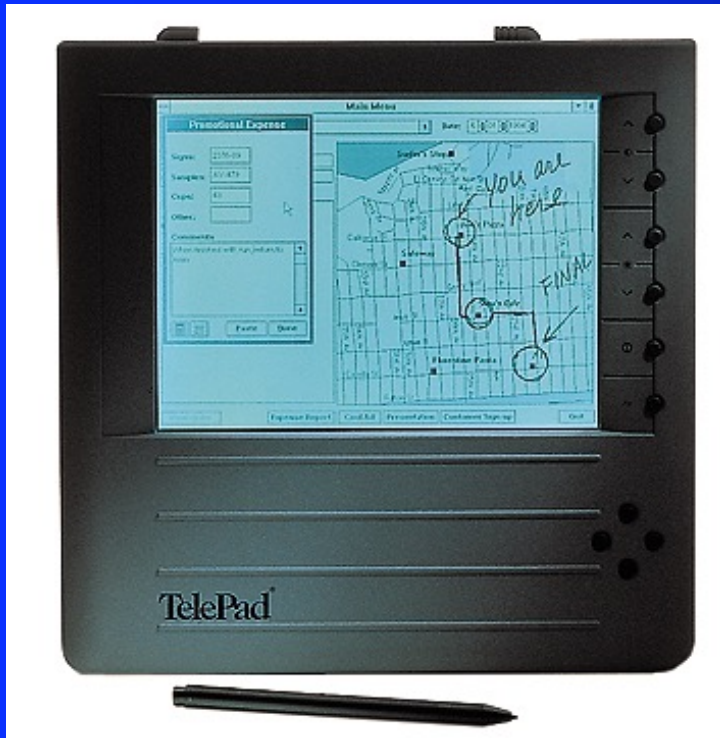
Fujitsu 325Point



- 1993
- Am 386SXLV/25
- PenWindows/PenPoint
- 8.7 x 11.7 x 1.2 inches
- 3.0 pounds
- US\$1,695
- Predecessor of famous Stylistic models

Early Pen Computers

TelePAD SL



- 1993/94
- Intel 386SL/25
- 11 x 11 x 1.3 inches
- 4.5 pounds
- PenWindows/PenPoint
- Field force solution
- Later futuristic TelePad 3

Early Pen Computers Compaq Concerto



- 1993/1994
- 486/25 and 486/33
- 250MB HD
- Active digitizer
- PenWindows
- Detachable keyboard
- Tablet PC....?

Early Pen Computers

IBM ThinkPad 700/710/730



- 1993/94
- The original ThinkPad
- Wacom digitizer
- Paperlike surface
- Intel 486/33
- 2 PC Card slots
- Pen Windows/PenPoint
- 3.5 pounds

Early Pen Computers

IBM ThinkPad 360P



- 1994
- Intel 486SX/33
- Convertible screen
- 2 PC Card slots
- 9.5-inch Color DSTN
- Pen Windows/PenDOS
- US\$2,899

Early Pen Computers

Toshiba T200 “DynaPad”



- 1994
- Intel 486DX2/40
- 5 hour battery!
- 9.5" Color or b&w
- Wacom digitizer
- US\$ 2,449

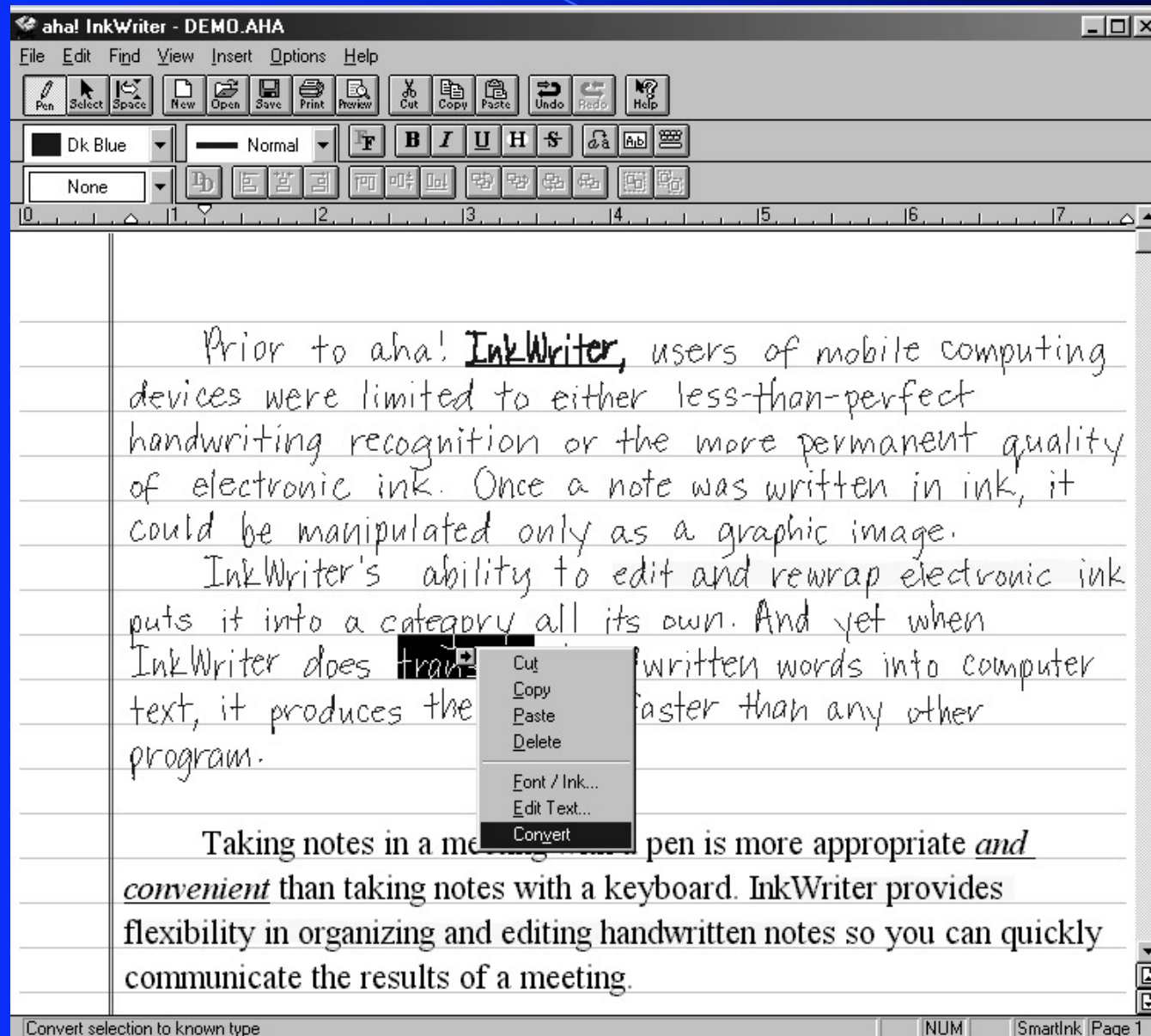
Crash 1993/94

- Momenta closes doors (1992)
- Samsung gives up after PenMaster
- NCR drops out
- GRiD sold to AST, liquidated
- Dauphin bankrupt
- AT&T buys GO/EO, EO bankrupt Aug 94
- Slate closes February 1994
- Compaq, IBM, NEC stop pen projects

Aha! InkWriter

- Ink processor for PenPoint and Pen Windows
- Introduced in June 1993 by aha! Software Corporation
- Smart ink, image processing, recognition
- Purchased by Microsoft
- Used in Windows CE Handheld PCs
- Technology returns in upcoming Tablet PC!

Aha! InkWriter



Handwriting Recognition

- The “Holy Grail” of pen computing
- Much more difficult than anticipated
- Different writing styles
 - Printed vs cursive
 - Neat vs sloppy
- Different methodologies
 - Trainable vs. “walk-up”
 - Character-based vs. word-based

Handwriting Recognition

- Some of the major products:
 - CIC Handwriter (still available to VARs)
 - ParaGraph CalliGrapher (now Microsoft Transcriber)
 - NestorWriter (Nestor primarily into OCR)
 - Lexicus Longhand (first cursive recognizer)
 - ART smARTwriter (still available)
 - Microsoft MARS and GRECO (part of Windows pen extensions)
 - Apple “Rosetta” (not used since Newton)

Handwriting Recognition

- Problems/challenges
 - Ambiguity in Western alphabets
 - Some character and number cannot be distinguished
 - Sloppy handwriting
 - “It’s the computer’s fault”
 - Poor digitizers
 - Poor editing tools
 - Computer cannot “fill in the blanks”

Newton MessagePad



- Introduced Summer 1993
- ARM 610 processor
- 240 x 320 screen
- Newton OS
- 4MB ROM
- US\$599 and more

Apple Newton

- In 1993, cartoonist Gary Trudeau made fun of the Newton's handwriting recognition in several strips



Apple Newton

- Another example of “Doonesbury” strip lampooning the Newton’s handwriting recognition



Newton Evolution



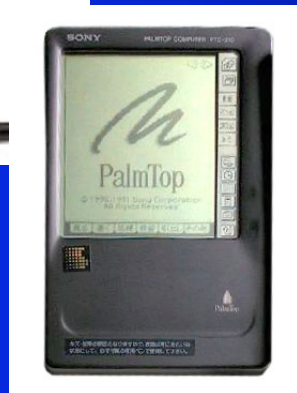
- Feb 94: MP110
 - Better recognition
 - Screen lid
 - AA batteries
- Mid 95: MP120
 - Newton OS 2.0 (Nov. 95)
- Mid 96: MP130
 - Backlight!
- Apr 97: MP2000
 - 190MHz StrongARM
 - 2 PC Card slots

Early PDAs: Amstrad PenPad



- 1993
- Eden Group, UK
- First PDA in US, Europe
- 3 Zilog Z80 processors
- PC Card slot
- US\$399

Early PDAs: Zoomer



- Created by Jeff Hawkins
- Sold as:
 - Tandy Zoomer (“Consumer”)
 - GRiDPAD 2390
 - Casio Z-7000
- GEOS OS
- PC Card slot
- Lots of software
- Inspired by Sony PalmTop PTC-310

Early PDAs

Sharp PT-9000

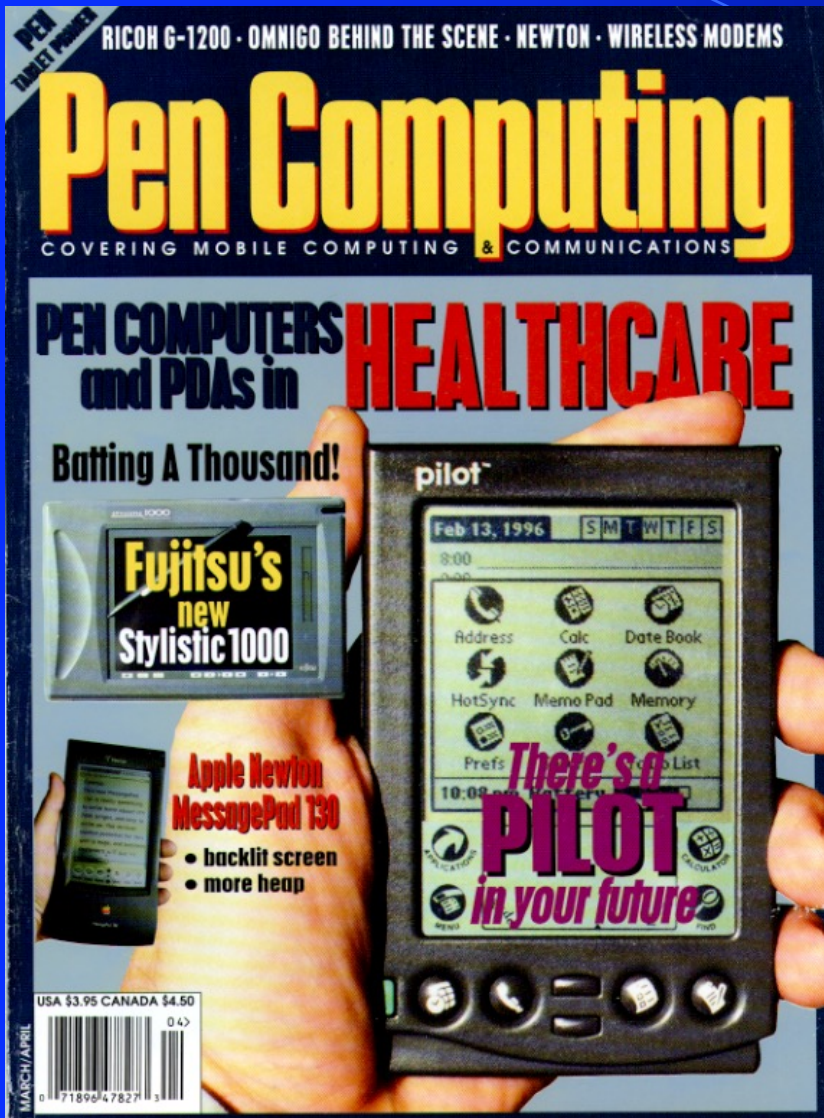


- 1994
- “Personal Info Assistant
- GEOS OS
- 9.2 x 6.4 x 1.4 inches
- No hard disk
- Touch screen
- US\$ 1,350

Graffiti



- Unistroke characters eliminate ambiguity
- Mnemonic shapes remind of alphabet
- Very fast, very small memory requirement
- Recognition accuracy near 100%
- Only problem: punctuation (.,:;”!?”- _ ~)



April 1996:
Palm/US Robotics
introduces
Palm Pilot

- small
- simple
- inexpensive
- no expansion
- no communication

WINDOWS CE NEWTON OS PALM PILOT WINDOWS FOR PEN PSION

Pen Computing
COVERING MOBILE COMPUTING & COMMUNICATIONS

Microsoft unveils the
Palm PC

Exclusive inside story

- Who are the designers
- What it will do to the Pilot
- When you'll be able to buy one
- Where Windows CE will go next
- Why this will change everything

All New Handheld PCs!

Panasonic CF-01
Windows 95 in a PDA-size box

NEC MobilePro 700

Phillips Velo 500

Novatel Contact

USA \$495 CANADA \$550

REAL WORLD TEST:
Dragon Systems Voice Recognition

February 1998

The image shows the cover of the January 1998 issue of 'Pen Computing' magazine. The cover is black with white and red text. At the top, it lists operating systems: 'WINDOWS CE NEWTON OS PALM PILOT WINDOWS FOR PEN PSION'. The main title 'Pen Computing' is in a large, bold, serif font. Below it, the subtitle 'COVERING MOBILE COMPUTING & COMMUNICATIONS' is in a smaller font. The main headline reads 'Microsoft unveils the Palm PC'. To the right of the headline is a photograph of a Palm PC device. Below the headline is a section titled 'Exclusive inside story' with a bulleted list of five items. At the bottom, there is a section titled 'All New Handheld PCs!' featuring images of several handheld devices: a Panasonic CF-01, a NEC MobilePro 700, a Phillips Velo 500, and a Novatel Contact. A price tag for the Novatel Contact is shown as 'USA \$495 CANADA \$550'. At the bottom right, there is a 'REAL WORLD TEST' section for 'Dragon Systems Voice Recognition' and the issue date 'February 1998'.

January 1998:
Microsoft introduces
Palm PC

- Everex
- Palmax
- Casio
- Compaq
- Philips

WINDOWS CE • PALM OS • PEN WINDOWS • PSION • DATAROVER

Pen Computing

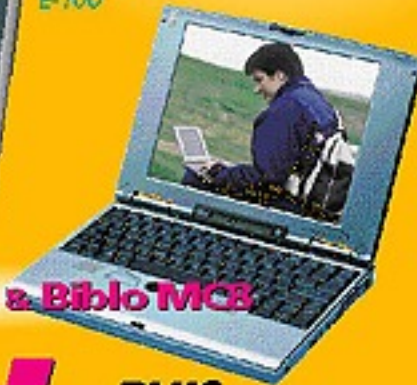
COVERING MOBILE COMPUTING & COMMUNICATIONS

ALL-NEW
ULTRAPORTABLES



Casio
Cassiopeia
E-100

Multimedia palmtops are here



Fujitsu

LifeBook B112 & Biblo MCB

3Com

Palm V

The Definitive Pen Lab Review



PLUS

- Symbol SPT-1700
- Wearable Computing
- Panasonic ToughBook
- Pens in Public Utilities
- Expanded Palm Section

USA \$4.95 CANADA \$6.95

JUNE 1999

June 1999: Multimedia Palm-size PCs

- HP
- Casio
- Compaq
- Philips

Pen Computing

COVERING MOBILE COMPUTING & COMMUNICATIONS



introducing the
POCKET PC

POWERFUL,
ELEGANT,
& COOL.



REVIEWS

- Casio Cassiopeia E-115
- Compaq iPAQ 3650
- HP Jornada 545
- Pocket Word
- Pocket Excel
- Pocket Streets
- Pocket MS Money
- Pocket MS Reader
- Pocket Windows Media
- Pocket Internet Explorer

USA \$4.95 (CANADA \$6.95)

PenLab

- Agere QBE Tablet
- Fujitsu Stylistic 3400
- Acer TravelMate 342T
- Xybernaut Mobile Assistant

April 2000:
Microsoft introduces
Pocket PC

- HP
- Casio
- Compaq
- Symbol

Palm vs. Microsoft

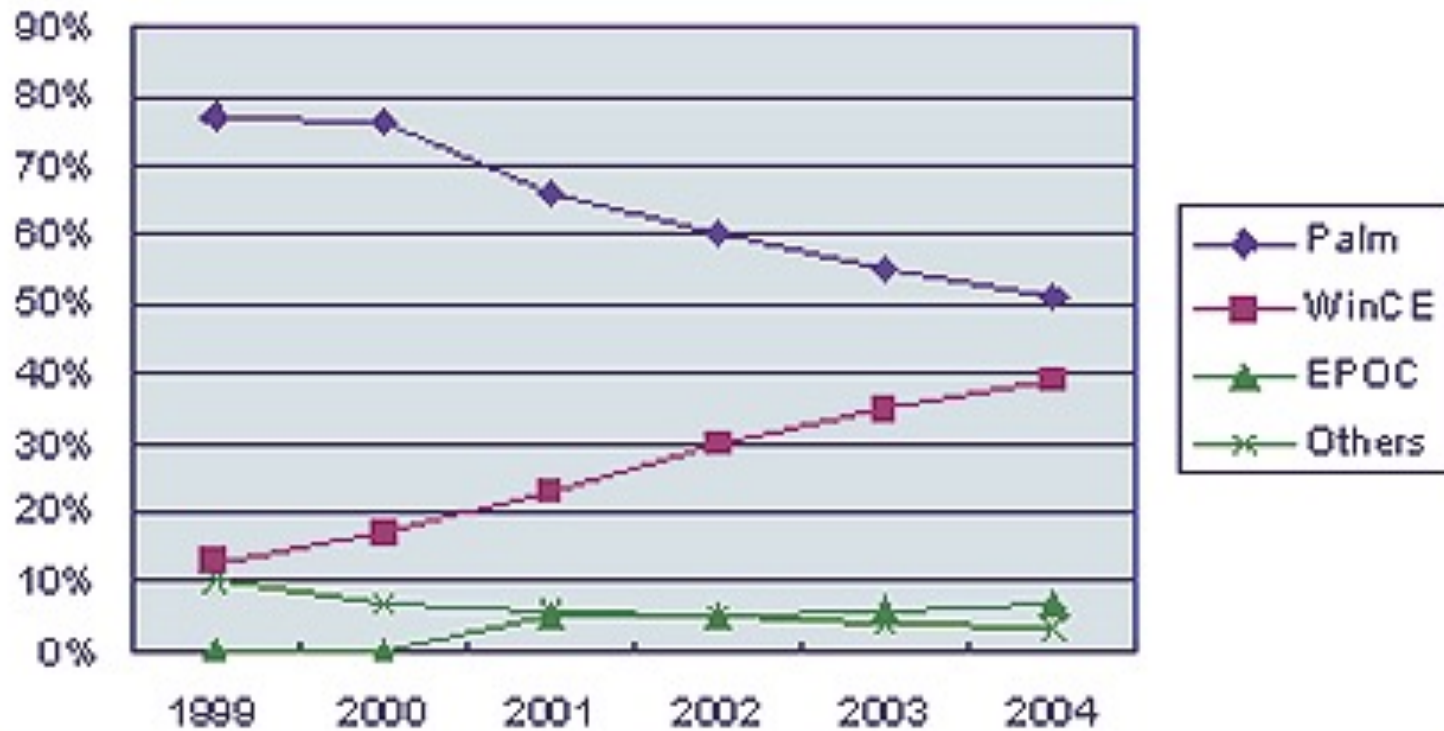
- Palm

- 75% global marketshare
- Fast and simple
- Aging OS
- Pushed to the limit
- 16 million sold
- Small company
- Very focused
- Low margin products
- Strong in wireless

- Pocket PC

- Gaining marketshare
- Complex
- Part of .NET
- Very powerful
- 2 million sold
- Huge companies
- No united front
- High margin products
- Wireless just beginning

Palm vs. Microsoft



OS Market Share, compiled by Digitimes

Recipe for PDA success:

- Battery life is essential
 - 6-10 hours is not enough. Go for 20 hours.
 - Offer snap-on extended batteries
- Screen quality
 - Only the best TFT is good enough
- Color is important
 - Black and white only for very low cost PDAs
 - 16-bit color or better mandatory

Recipe for PDA success:

- Reflective/transmissive display?
 - New Pocket PCs all use reflective
 - Offer both standard and reflective
- Flash memory!
 - Data loss on dead battery is unacceptable
 - Move to Flash storage of user data
- Expansion card problem
 - Too many standards!
 - Agree on one or two

Recipe for PDA success:

- **Wireless connectivity important**
 - Offer internal 802.11b, perhaps Bluetooth
 - Offer internal “always-on” packet radio
- **Industrial design**
 - Know US consumer taste
 - Learn from Palm V and iPAQ
 - Improve quality of voice recorder
- **Color and materials**
 - Business tool versus “toy”

Recipe for PDA success:

- Packaging
 - Lots of shelf space → eye-catching packaging
- Marketing/advertising
 - Consumers still must be educated to PDAs
 - Some US firms do a good job, others do not
 - Example: Microsoft: “We will not be advertising in any mobile magazines as we have a different focus.”
- Screen lid to prevent scratching
- Power supply
 - Small, don't hog the power strip
 - Clearly marked

Future of Tablets and Pads?

- We KNOW that PDAs work because tens of millions have been sold
- We don't know if tablet computers work as they have failed in the past
- Let's see why they failed and what has changed

Pens: 1992 vs 2001

- 1992: Hardware not advanced enough
 - Same hardware worked fine with notebooks
 - Hardware was never the primary problem
- 1992: Handwriting recognition didn't work
 - True, and not much progress has been made
 - However, faster hardware helps!
- 1992: Pen computers too expensive
 - Cost of digitizer added US\$500-1000
 - Pen computers must not be more expensive!

Pens: 1992 vs 2001

- 1992: People lost expensive pens
 - Still a problem with active digitizer
 - Use backup (pointing device, touch screen)
- 1992: No communication
 - Include wireless radio (802.11, BlueTooth, etc.)
- 1992: OS not optimized for pen!
 - May still be true
 - Let's hope Microsoft gets it right

The Future of Pen Computing

- National Semiconductor on WebPAD:
 - “Information Appliances that use National Semiconductor's WebPAD technology are compact web access devices for home or commercial applications. Weighing approximately three pounds and about the size of the average notebook, WebPAD appliances are designed to be comfortable to hold and easy to use. With features like very short start-up, "instant on" access, touchscreen technology, long battery life and no "crashing," these lightweight devices provide a simple, user-friendly gateway to the information superhighway.” (<http://www.national.com/appinfo/solutions/>)

The Future of Pen Computing

- Microsoft on Tablet PC:
 - “The Tablet PC device, which should be available in 2002, will allow users to access e-mail, calendar, project files or even complete databases while away from their desktop PCs. Roughly the size of a paper notebook, the Tablet PC will allow users to take handwritten notes on the screen and move, highlight, save, sort and search these notes -- thanks to new “digital ink” technology. With Tablet PC, users will have the power of a computer with the simplicity of paper.” “We believe the Tablet PC will spark a new generation of innovations in both hardware and software that will bring new excitement to the market.”
(<http://microsoft.com/windows/tabletpc/>)

Future of Pen Computing

- Alan Kay (Dynabook visionary):
 - Alan Kay said in June 2001: “The closest thing to a Dynabook right now is the Microsoft Tablet -- done by Chuck Thacker and Butler Lampson, two of the principals at PARC in the 70s. However, they, too, made the mistake of leaving off the keyboard. We knew back in 1968, via the first great character recognition system, GRAIL done at RAND in 1966, and better than Graffiti, that even a perfect and instant recognizer would not do the job. The recognizer would be for controls, fixing typos, and short 'fill in the blank' type stuff, and you would want a keyboard for paragraph length typing. No one has made a commercial device yet with the particular combination that seems to be needed.”
(Alan Kay to MacCentral.com in June 2001)

Tablet PC: Fall 2001

Comdex: Acer Convertible



Recipe for pen tablet success:

- Concentrate on ink but don't forget handwriting recognition
- Not more expensive than standard notebook
- Must not get hot when in use
- No annoying fan
- Backup for active digitizer
- Instant-on and instant off
- User interface designed for pen, not mouse
- Cool, attractive design
- Built-in wireless communication

Thank you and
good luck!