▼ The Mac's Effect on 21st Century Networking - A Technical Overview
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▼ Overview overview
- The Mac has pioneered many, if not most, of the features of today's personal computer
- Likewise the Mac has pioneered many of the features of today's computer networks
- This talk is a historical and technical overview of the Mac's effect on today's networking

▼ The Mac's effect on me
- Started at Apple in August, 1983
- Co-developer, AppleTalk Network System, co-author, "Inside AppleTalk"
- Led AppleTalk Phase 2, Apple Internet Router, Apple Remote Access development
- President and founder of Open Door Networks, Inc., 1995 - present

▼ Some pre-history
- Lisa computer introduced January, 1983. Aimed at businesses.
- ▼ "AppleNet" local-area network announced for fall, 1983, target price $500
  - 1 Mbps CSMA/CD bus-based network
  - XNS protocol stack
  - A "me too" network
- AppleNet canceled, fall 1983

- The dawn of history

▼ Macintosh "network" plans
- Mac development ongoing since 1979
- Mac hardware designed as "closed" system
- Ports for serial connections, floppy drive
- ▼ Serial ports implemented through SCC chip:
  - The $5 decision that spawned an industry
- Vague plans for some sort of "peripheral bus"

▼ 1983
- Lisa shipping, but doing poorly
- Mac development full-steam ahead
- Few resources available to address "peripheral bus" (a.k.a. AppleBus) idea
- But lots of resources on Lisa (and even Apple-//) networking
- The handwriting was on the wall...

▼ "You're either on the bus, or you're not"
- October, 1983: AppleNet effort, for both Lisa and Apple-// canceled
- Hardware and software resources redirected to AppleBus
- Three months until the Mac announcement!

▼ AppleBus background
- Originally envisioned as a master/slave polled system for peripherals
- Capabilities, speed dependent on SCC
- The redirected team, led by G. Sidhu, envisioned more than just a bus
- A real network would require distributed control, additional protocols and hardware

▼

▼ Not just any network...
- ▼ But a network worthy of the Macintosh:
  - User-installable
  - No static address configuration
  - No "terminators"
  - Easy service location
  - Open to developers
- The first plug-and-play network

▼ We were going to have to invent a lot!
- No CSMA/CD hardware -> CSMA/CA
- No terminators -> self-terminating connectors
- No static addresses -> new address assignment methodology
- Easy service location ->
  new protocol suite

▼ January, 1984
- Macintosh announced January 24, 1984
- Aimed at "the Rest of Us"
- ▼ Included "...an incredible thing called AppleBus interconnect" built in
  - Which was still being invented...

▼ 1984
- A busy, busy year!
- Productize AppleBus hardware
- Design, implement, test network protocols
- Develop key end-user products
- ▼ Energize developers
  - Developers' conference
  - Tools

▼ Compromises needed
- Maximum speed 230.4 Kbps
- Maximum distance: 1000 feet
- Maximum of 32 nodes per LAN
- But only $50 per node, and no compromise in ease of use!

▼ But plan for the future
- Addressing supported up to 255 nodes per LAN
- Additional data links envisioned
- ▼ Complete internet (small-i) architecture designed in from the beginning:
  - "Bridges" to interconnect LANs
  - "Zones" to simplify service location

▼ Key innovations
- CSMA/CA (US Patent #4,661,902)
- Dynamic address assignment (#4,689,786)
- Dynamic naming and service location

- Internet (small-i) architecture
▼ CSMA/CA
  - Distributed, shared-medium communication without the ability to sense collisions
  - "Necessity is the mother of invention"
  - Enabled Mac networking for years
  - Similar techniques used for both 802.11 and certain cellular systems
  - First patent just expired
▼ Dynamic address assignment
  ▼ Grew out of both necessity and desire:
    - Macs had no fixed ID
    - Mac users shouldn't have to configure addresses
  ▼ Now nearly pervasive:
    - DHCP, link-local addressing, IPv6
    - Peripheral buses like USB
▼ Dynamic naming and location
  ▼ Grew out of necessity and desire:
    - Fixed addresses not available
    - Mac users shouldn't have to remember and type in addresses (or even names)
  - Way beyond DNS
  ▼ Now becoming much more common:
    - SLP, ZeroConf (Rendezvous), Windows
▼ Internet architecture
  - We didn't invent the Internet!
  - We did invent an internet (small i)
  - We did set the foundation for making sure internets could be easy to use
  - More later
▼ End-user applications
  - Ongoing "LightWriter" development
    was key
  - File server planned for late 1985
  - Work on an IBM PC card underway
  - Third party applications underway
▼ The Mac can connect to anything...
  - ...as long as it's a LaserWriter
  - Work with Canon, Adobe, Aldus
  - Sharing the LaserWriter could make it affordable, break network vicious circle
  - The start of desktop publishing
▼ Laser printing
  - We didn't invent the laser printer
  ▼ We did make it accessible to the Rest of Us
    - Under $10K
    - Easily networked and used

- We didn't invent Postscript either
- 1985: The Macintosh Office
- ▼ The Macintosh Office
  - "AppleTalk" Personal Network
  - Mac 128 and 512 and XL (nee Lisa)
  - LaserWriter printer
  - "File Server" to ship later
  - Third-party API
- ▼ 1986
  - Mac Plus announced, shipped
  - First machine to include AppleTalk in ROM
  - 1 MB RAM, SCSI connector
  - HD 20 SC
  - What file server?
- ▼ A life of its own
  - BMUG creates, Farallon commercializes PhoneNet
  - AppleTalk switches appear
  - AppleTalk speed-up products attempted
- ▼ AppleShare 1.0
  - Shipped January, 1987
  - ▼ AFP 1.0 supported Macs, IBM PCs
    - Apple-// added later
  - AppleTalk PC card soon thereafter
  - Mac SE and II announced at same time...
- ▼ Beyond 230.4
  - Mac II had Nubus architecture
  - "Ethernet" was starting to become prevalent (although IBM still didn't get it)
  - "AppleTalk" was too slow
  - The time was right for "EtherTalk"
- ▼ EtherTalk 1.0
  - Shipped mid 1987
  - "A faster AppleTalk"
  - Included EtherTalk card
  - Up to 255 nodes per network
  - "AppleTalk Personal Network" to be renamed to LocalTalk
- ▼ Routing: a digression
  - Full internet architecture envisioned from day one
  - But "bridges" (routers) were too low volume
  - Apple had to develop protocols, set standards
  - EtherTalk <-> LocalTalk "bridge" needed
  - Let others build routers
- ▼ Too much success
  - ▼

- ▼ 130,000 networks shipped by end of 1987
  - >3x any other network (3Com, Novell)
- ▼ High university, corporate interest
  - Mixed protocol networks common
- Ethernet becoming the standard
- ▼ AppleTalk Phase 2
  - ▼ Time to re-invent some things
    - We were reaching (expected and unexpected) limits
  - ▼ Couldn't "throw it all out and do it again"
    - Foreshadowed other transitions (PowerPC, OS X, IPv6)
- ▼ 1989
  - Earthquake!
  - ▼ Significant AppleTalk enhancements
    - >255 nodes per network
    - Multiple zones per network
    - "Better citizen" on large networks
  - Major product introductions in NYC confirm networking had come into its own
- ▼ Getting friendlier, 1991
  - Quadra 700,900: first Macs with built-in Ethernet
  - Apple Ethernet System ("FriendlyNet") brought LocalTalk innovations to Ethernet
  - Non-standard Ethernet connector
  - ▼ Supported different cabling systems
    - 10BaseT won out
- ▼ System 7
  - Biggest overhaul to Mac OS since 1.0
  - ▼ Included "Personal File Sharing"
    - Scaled-down AppleShare server
    - Full AFP implementation
    - The first peer-to-peer networking
  - Apple Events debuted as well
- ▼ AppleTalk Remote Access (ARA)
  - Newly-introduced PowerBooks were incredibly popular
  - Users wanted ways to connect back to their organizations' networks
  - Ad hoc solutions needed to be standardized
  - Wanted to ship it with every PowerBook
  - Modem speeds up to 9600 Kbps
- ▼ Dial-up networking
  - We didn't invent dial-up
  - We did envision it from day one
  - We did popularize it courtesy of the success of the PowerBooks
  - We helped in the Internet's transition from SLIP to PPP
- ▼ PowerTalk (AOCE) - way ahead of its time

- E-mail in the OS (System 7 Pro)
- Directory services
- Public key encryption
- Digital signatures
- Keychain

▼ PowerTalk: the Newton of Networking
  - ▼ You can't innovate without risks:
    - Technology not quite ready for prime-time
    - Users not quite ready for the technology
  - But got people thinking about it
  - Most of its technologies are now popular

▼ Measured steps toward the Internet
  - Work with the Internet Engineering Task Force (IETF) to tunnel AppleTalk over the Internet
  - Apple Updated-based Routing Protocol (AURP) - RFC 1504
  - Other work on MacIP, SNMP, PPP, SLP

▼ 1994
  - The start of the end of an era
  - 1984 + 10
  - The historian changes his viewing point
  - ▼ MacTCP ships with System 7.5
    - Internet API built into the system

▼ Macs and the Internet: a (long) digression
  - 1984: The University Consortium
  - Many universities were on the ARPAnet, which used new TCP/IP protocols
  - Unix included TCP/IP
  - Ethernet quickly becoming standard
  - Original Macs only supported LocalTalk

▼ More Internet digression
  - ▼ Stanford pioneered AppleTalk-to-IP work
    - MacIP (TCP/IP over LocalTalk)
    - Gateway to pass TCP/IP between LocalTalk and Ethernet
  - Ad hoc software began to appear
  - 1988: MacTCP created and licensed to universities and developers

▼ Universities do the rest
  - Fetch (1989) - FTP
  - Eudora (1990) - email
  - NewsWatcher - newsgroups
  - NCSA Telnet - remote login
  - NCSA Mosaic -> Netscape (1994)

▼ What about the rest of us?
  - Around 2 million "hosts," 1000 web sites
  - ▼ Internet dial-up just getting started

- SLIP being replaced by new PPP
- Third-party plug-ins to MacTCP
- EarthLink founded, March 1994
▼ And one more (parallel) digression
- AppleLink, run be GEIS, debuts for Apple internal communications in 1985
- AppleLink Personal Edition created to expand AppleLink's reach to customers
- AppleLink Personal Edition is spun off as America Online, 1989
- A tale of two decades
▼ Macs take the early lead
- Built-in network h/w and s/w
- + Numerous third-party Internet apps
- + Open standards of the Net
▼ = Macs as best Internet platform
- 2-3x market share
- Internet client, content creator and server
▼ Key commercial apps
- Netscape Communicator
▼ PageMill
- First WYSIWYG HTML editor
- Established Mac as best content creator
▼ WebSTAR
- Commercial quality Web server
- But with Mac's ease of use
▼ Apple keeps the ball rolling
▼ Apple Internet Connection Kit (AICK)
- Full Internet client in Mac OS 7.6
- CyberDog
- Apple Internet Server Solution (AISS)
- PPP in the OS
▼ Another digression: Open Transport
▼ MacTCP had been almost an afterthought
- Not "built in"
- Different API from AppleTalk
- Open Transport unifies architecture
- TCP no longer "second class citizen"
- A rough start
▼ The Microsoft "alliance"
- Microsoft invests $150M in Apple
- Microsoft continues Office for Mac development
- Apple ships IE as default Web browser
▼ Starting to put things back together
▼ Mac OS 8

- Netscape and Microsoft Internet Explorer
- Java
- Personal Web Sharing
▼ AppleShare IP
  - Start of AppleTalk -> IP
    migration
▼ Thinking different
(changing the world again)
  ▼ The iMac, May 1998
    ▼ The first Mac without LocalTalk
      - But Ethernet and modem
    - Got Apple back on track
    - Enabled what was to come next...
▼ The World goes Wireless
  ▼ AirPort, July 1999
    - Agreement with Lucent makes 802.11 affordable, breaks another vicious circle
    - iBooks announced concurrently
    - The rest is history
▼ Wireless networking
  - We didn't invent 802.11 (had to say it)
  ▼ We had been looking at wireless for years before
    - Patent #5,745,699 "Dynamic address assignment in an arbitrarily connected network"
  - Techniques date back to LocalTalk
▼ Things really come together
  ▼ Mac OS 9, "The Best Internet OS Ever"
    - Sherlock Internet searching
    - Keychain password integration (again)
    - Internet software updating
    - TCP/IP file sharing and AppleScript
    - Dynamic IP service location (SLP)
▼ An example effect: Service location
  ▼ Mac's user-centric focus ->
    ▼ AppleTalk's user-centric focus ->
      ▼ Name Binding Protocol (NBP) ->
        ▼ Service Location Protocol (SLP) ->
          - Rendezvous (ZeroConf)
▼ Oh yeah... Security
  - One of the Mac's best kept secrets
  ▼ Stems from user-centric approach
    - Network services off by default
    - Simple interfaces
    - Always been a focus

- An alternative to the Microsoft monoculture
- Modern History
- ▼ Mac OS X Server (10.x)
  - Unix a "modern-day" OS
  - ▼ Base for Internet-standard servers
    - Especially Apache
    - But infinitely easier to set up
  - Apple value-add: AFP, NetBoot, QTSS
  - XServe provides real Mac server hardware
- ▼ "Consumer" networking
  - Apple Store, 1997
  - iTools, 2000 (especially iDisk)
  - iTunes, 2001
  - iChat, 2002, iChat AV, 2003
  - iTunes Music Store, 2003
- ▼ Open Door's effect on Apple's effect
  - Early Mac Web server tools
  - TCP/IP Personal File Sharing (ShareWay IP)
  - Security products (DoorStop, Who's There?)
  - Envision: a new way to experience the Web
- Here's to the crazy ones. The misfits. The rebels. The troublemakers. The round pegs in the square holes. The ones who see things differently...

  Because the people who are crazy enough to think they can change the world, are the ones who do.
- And here's to the Mac's third decade. May we always think different!
- www.opendoor.com/nethistory