How the FreeBSD Project Works

10 March 2007

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Introduction

- What is FreeBSD?

- What is the FreeBSD Project?

- How does the FreeBSD Project work?

- And does it all depend on who you ask?

  – Caveat: kernel developer!

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Introduction to FreeBSD

- Open source BSD UNIX-derived OS

- ISP server network server platform

  - Yahoo!, Verio, NY Internet, ISC, ...

- Appliance/product/embedded OS foundation

  - Juniper, Nokia, NetApp, Panasas, Timing Solutions, Secure Computing, nCircle, The Weather Channel

  - VXWorks, Mac OS X, ...

- One of most successful open source projects

- Focus on storage, networking, security

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Introduction to FreeBSD (cont)

- Active development community

  - Central source repository and revision control

  - Extensive online community

  - Over 340 active CVS committers

  - Thousands of contributors

- Liberal Berkeley open source license

  - Designed to maximize commercial reuse

  - No requirement that derived works be open source

  - Extensive use in commercial, research systems

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What do you get with FreeBSD?

- Complete, integrated UNIX system
  - Multi-processing, multi-threaded kernel
    - Intel/AMD 32/64-bit, Itanium, sparc64, ARM, PPC
  - UNIX, POSIX, BSD programming interfaces
  - Multi-protocol network stack
    - IPv4, IPv6, IPX/SPX, AppleTalk, IPSEC, ATM, Bluetooth, 802.11, SCTP, ...
  - Standard and embedded build/integration targets
  - Extensive documentation
- Over 16,600 third party software packages

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The FreeBSD Project

- One of the most successful open source projects in the world
  - Can't throw a stone without hitting FreeBSD
    - Root name servers
    - Major web hosts, search engines
    - Routing infrastructure
    - Foundation for major commercial operating systems
  - And much more...
- But the FreeBSD Project is more than software

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What the Project Is Depends on Who You Ask

- FreeBSD Core Team Member

- FreeBSD src Developer

- FreeBSD portmgr Member

- FreeBSD Documentation Team Member

- FreeBSD Users

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FreeBSD Project

- Global community of developers and users
  - FreeBSD.org web site, mailing lists
  - Developer community
    - Core team
    - Committers
    - Ports maintainers
    - Contributors
  - User community
    - User groups, advocacy, training, ...
  - FreeBSD Foundation

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FreeBSD Foundation

- Non-profit organization based in Boulder, CO

    - Sponsored development

    - Intellectual property, contracts, licensing, legal

    - Developer travel grants

    - Event sponsorship

    - Hardware purchase

    - Collaborative R&D agreements

- Support the FreeBSD Project – consider a donation today!

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What the Project Produces

- FreeBSD kernel, user space

- Security officer, release engineering

- Ports collection, binary packages

- FreeBSD releases

- Manuals, handbook, web pages, marketing

- Technical support, debugging, etc.

- A variety of user/community events

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Things We Consume

- Beer, soda, chocolate, and other vices

- Donated and sponsored hardware

  – Especially in racks, with hands

- Bandwidth in vast and untold quantities

- Travel grants, salaries, contracts, grants

- Thanks, user testimonials, good press

- Yet more bandwidth

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Who are the Committers? (2006-2007)

- Locations
  - 34 countries
  - 6 continents

- Ages
  - Oldest (documented) committer born 1948
  - Youngest (documented) committer born 1989
  - Mean age 32.5, median age 31, stddev 7.3

- Professional programmers, hobbyists, consultants, university professors, students ...
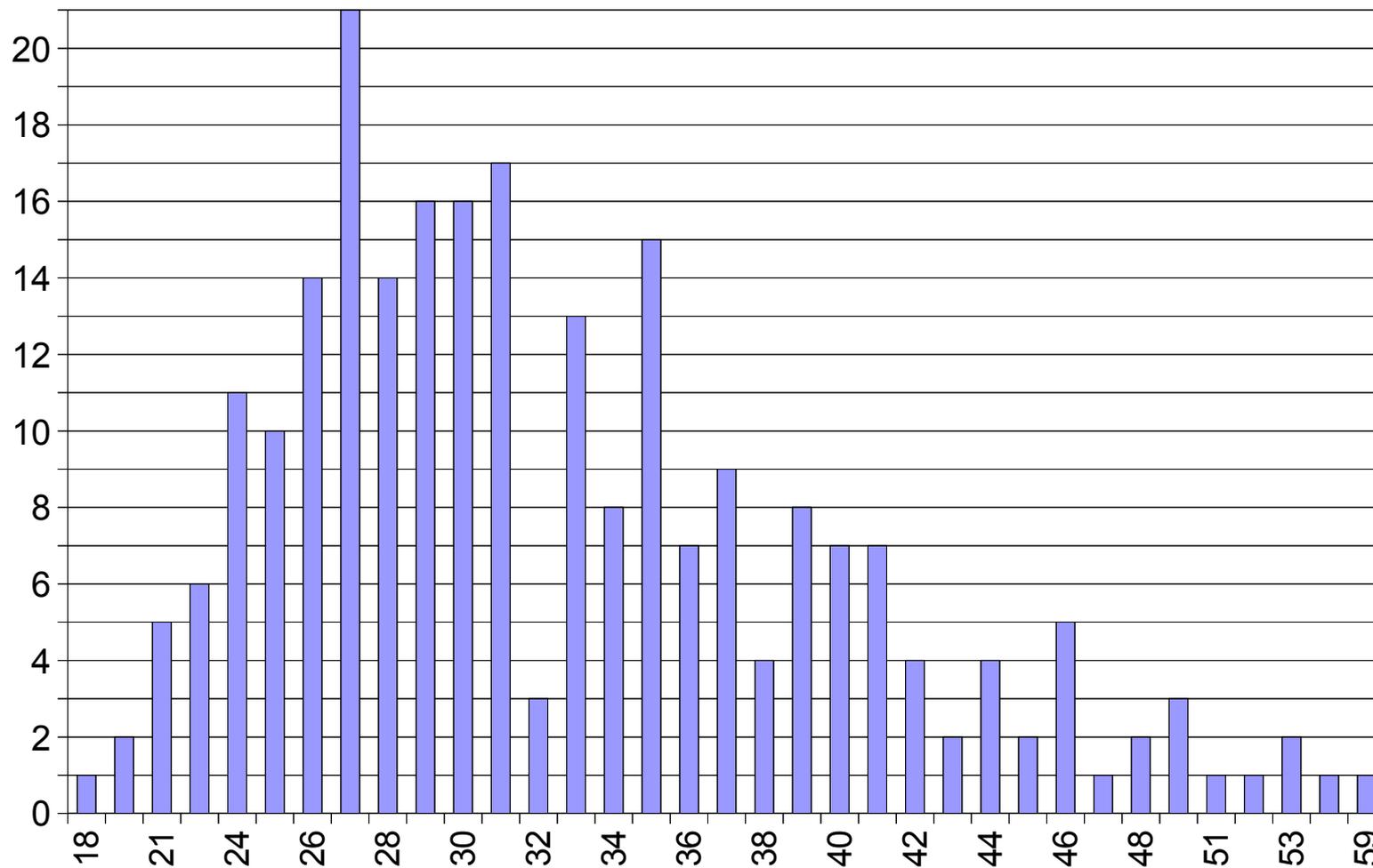
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Locations of FreeBSD Committers (March 2007)

FreeBSD locations

committers ftp submitters
Data from `astro/xearth/files/freebsd.*.markers`,
updated 2007/03/09 22:25:16.

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FreeBSD Developer Age Distribution (March 2007)

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FreeBSD Processes

- Committer life cycle and commit bits

- Core Team

- Mailing Lists

- Web pages, documentatoin

- Groups/projects

- Derived projects

- Events

- Development cycle

- Release Cycle

- CVS and Perforce

- Clusters

- Conflict resolution

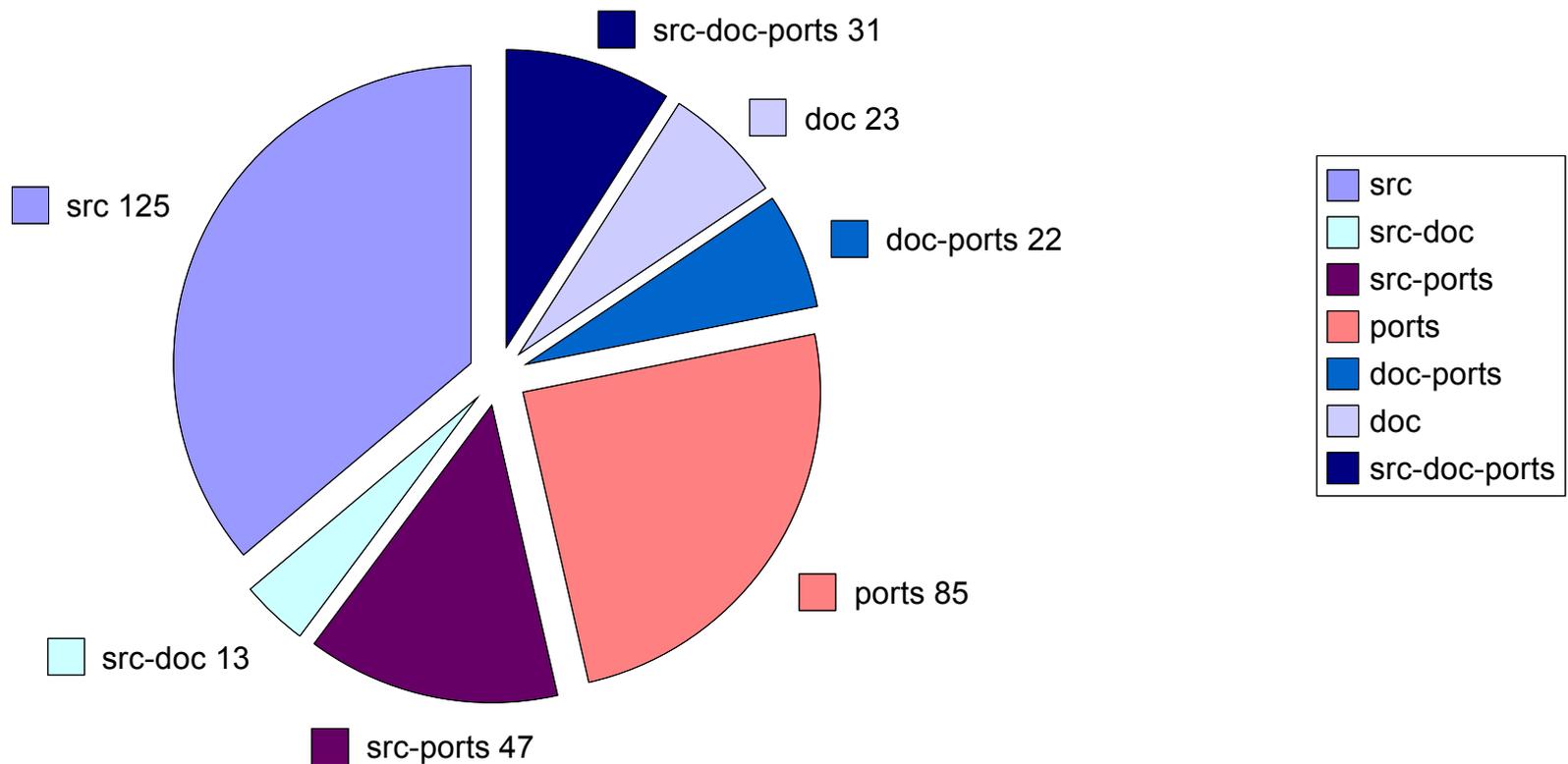**UNIVERSITY OF CAMBRIDGE**

FreeBSD Committers

- Committer is someone with CVS commit rights

- Selected based on key characteristics

  – Technical expertise

  – History of contribution to the FreeBSD Project

  – Ability to work well in the community

  – Having made these properties obvious!

- Key concept: mentor

  – Mentor proposes to core@ (portmgr@, doceng@)

  – Guide through first few months of committing

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Number of Commit Bits by Type (May 2006)

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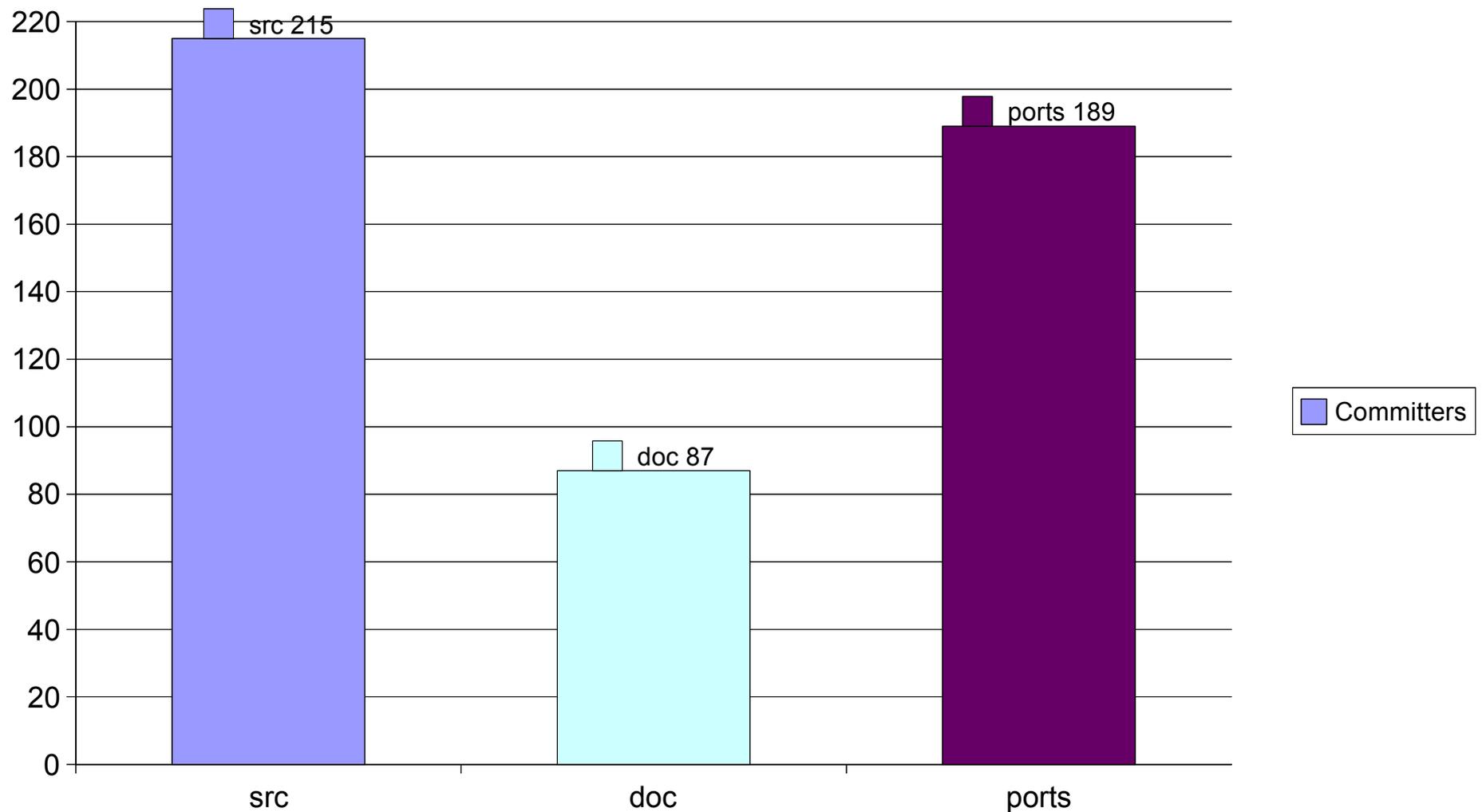
Distribution of Commit Bits (March 2007)

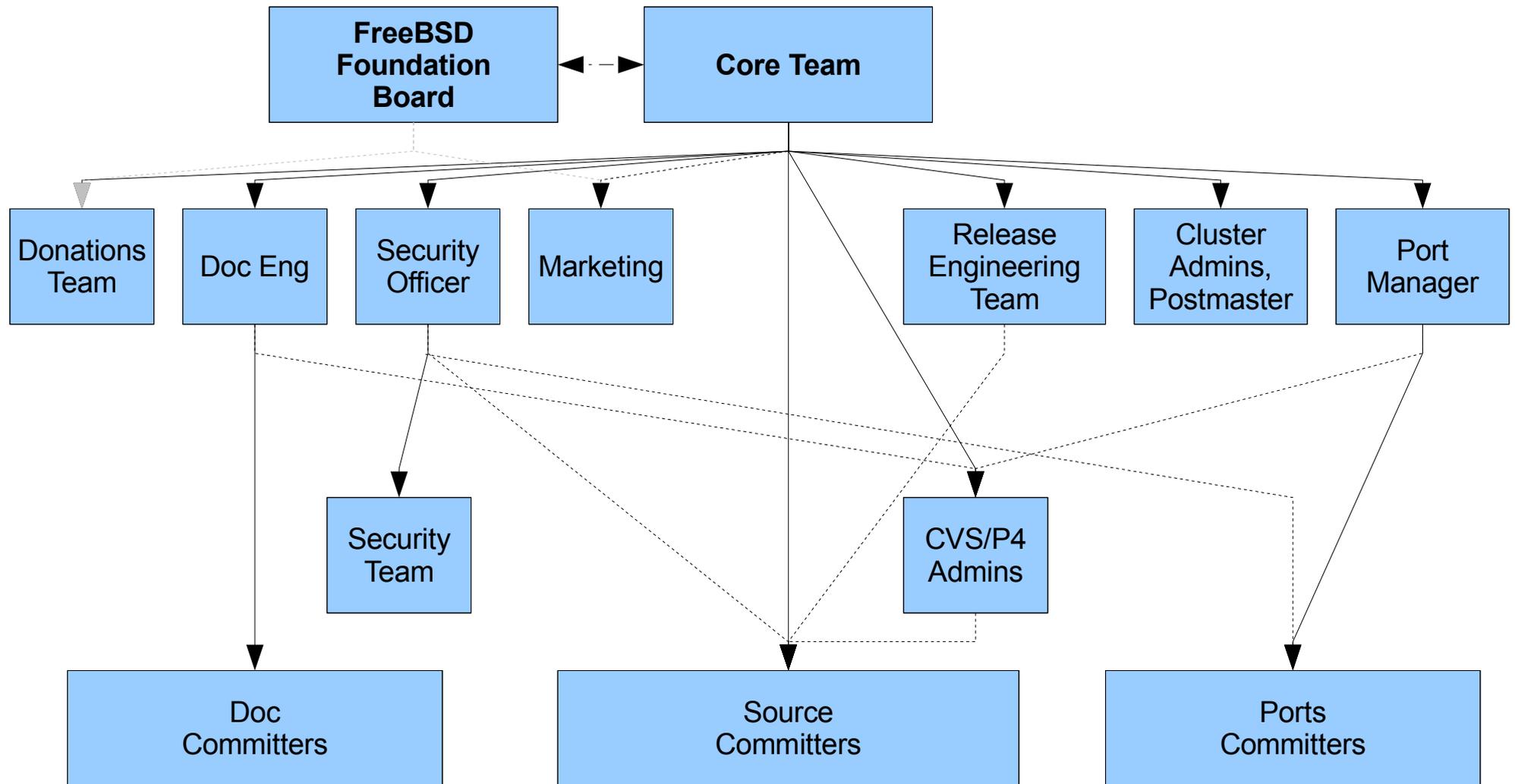## 348 Total Committers

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FreeBSD Core Team

- 9-member elected management body

  – Votes and candidates from the full set of active FreeBSD committers

  – Core secretary

- Responsibilities

  – Administrative (commit bits, hats, team charters)

  – Strategic (project direction, coordination, cajoling)

  – Rules, conflict resolution, enforcement

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Ports Committers, Maintainers

- Slightly stale data, of course (~2006)

  - 158 ports committers

  - Over 1,500 ports maintainers

  - Over 16,600 ports

- Averages

  - 85 ports/committer

  - 9 ports/maintainer

  - 8 maintainers/committer

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FreeBSD Project Org Chart (Sort of)

FreeBSD Foundation Board ◄--► Core Team

Donations Team

Doc Eng

Security Officer

Marketing

Release Engineering Team

Cluster Admins, Postmaster

Port Manager

Security Team

CVS/P4 Admins

Doc Committers

Source Committers

Ports Committers

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Groups and Projects

- Developers

  – Source Developers

  – Core Team

  – Core Team Secretary

  – Release Engineering Team

  – Release Engineering Build Teams

  – Security Officer

  – Security Team

  – Ports Team

  – Port Managers

  – Doceng Team

  – Documentation Team

  – Vendor Relations Team

- Administrative

  – Foundation Board of Directors

  – Foundation Operations Manager

  – FreeBSD.org admins@

  – FreeBSD.org webmaster

  – Sentex cluster admins

  – ISC cluster admins

  – Mirrors Team

  – Donations Team

  – Marketing Team

  – Perforce Admins

  – CVS Admins

  – Postmaster

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Wait, I'm Not Done Yet!

- Administrative (cont)
  - CVSUP Mirrors Team
- Other Contributors
  - Perforce Contributors
  - Questions Subscribers
- Software Adaptation Projects
  - FreeBSD GNOME Project
  - FreeBSD KDE Project
  - Mono on FreeBSD
  - OpenOffice.org on FreeBSD
  - Java on FreeBSD

- Special Projects
  - Stress Testing
  - FreeBSD Tinderbox
  - FreeBSD Standards
  - SoC Mentors
  - Monthly Status Reports
  - Coverity Team
- External Projects
  - KAME Project
 - TrustedBSD Project
  - PC-BSD
  - DesktopBSD

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Derived Projects and Organizations

- Interesting and important growth in ecosystem

- Projects that consume FreeBSD but produce something new and different

  - FreeSBIE, pfSense, PC-BSD, Darwin, DesktopBSD, DragonflyBSD, FreeNAS, ...

  - Features to flow up- and down-stream

  - Avoid stepping on toes of derived projects, while fostering their growth

- Shows scalability of community model

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Mailing Lists

- Over 60 active central mailing lists

- Mostly public

  - Some exceptions (core, re, so, portmgr, ...)

- Organized loosely by topic

  - -announce, -current, -arch, cvs-all, -security, ...

  - -chat, -hackers, -questions...

- Place where vast majority of FreeBSD discussion and planning takes place

  - Both developer and user

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FreeBSD Project Web Pages
(Just a few)
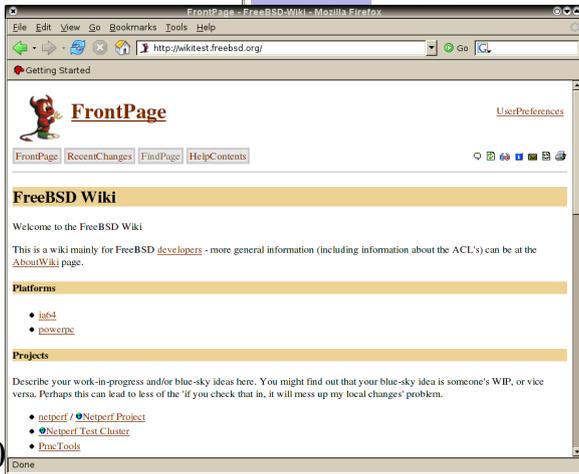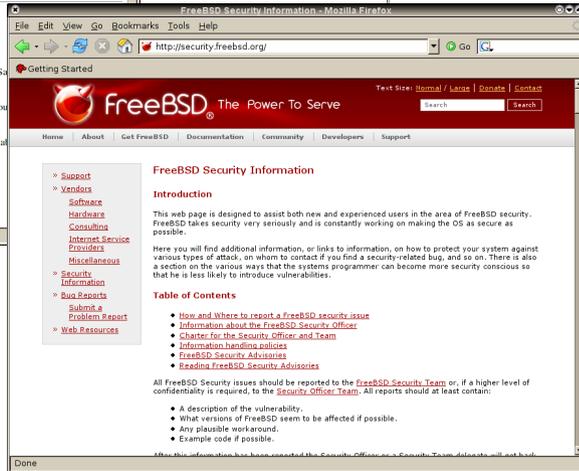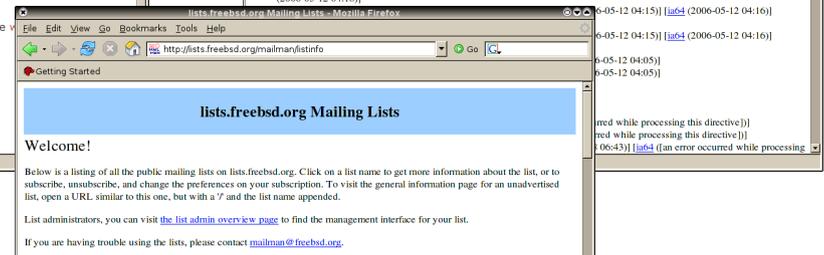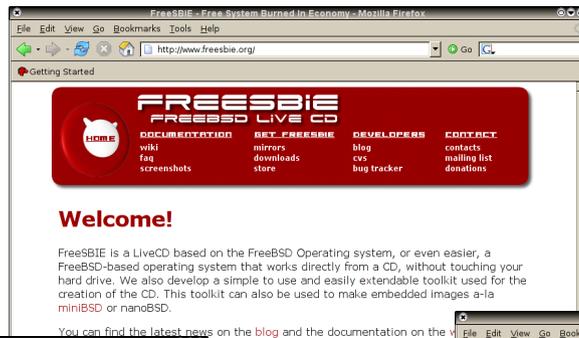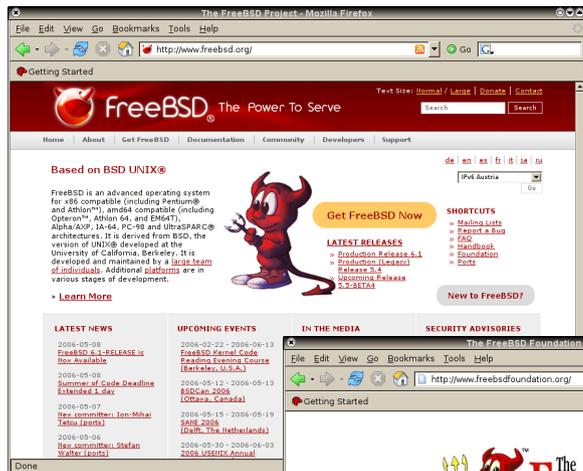
Events

- Conferences
  - USENIX ATC
  - BSDCan
  - BSDCon
  - EuroBSDCon
  - AsiaBSDCon
  - NYCBSDCon
  - MeetBSD
  - BSDConTR

- Developer Summits
  - Two day events, at conferences
  - March 2007: AsiaBSDCon, Tokyo, JP
  - May: BSDCan 2007, Ottawa, CA
  - September 2007, EuroBSDCon, Copenhagen, DK

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FreeBSD Developer Summit BSDCan May 2006

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A Few Highlights
Developer Summits, 2006

- Network stack virtualization

- Xen, Sun4v

- SCTP

- 32-processor systems

- Multi-threaded, multi-processor network stack performance

- Interrupt filters

- FreeBSD/embedded

- FreeSBIE 2

- FreeBSD 802.11

- Ports

- TrustedBSD Audit

- ZFS, GJournal

- Revision control

- gcc4

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FreeBSD Development Cycle

- Branched development model
  - 7-CURRENT – Cutting edge development
  - 6-STABLE – Active development with releases
  - 5-STABLE – Legacy branch with releases
  - 4-STABLE – Legacy branch
- Goal
  - 18-24 month major "dot zero" releases (6.0, 7.0, ...)
  - 4-6 month minor "dot" releases (5.5, 6.1, 6.2, ...)
- Balance is tricky but important

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Development Branches
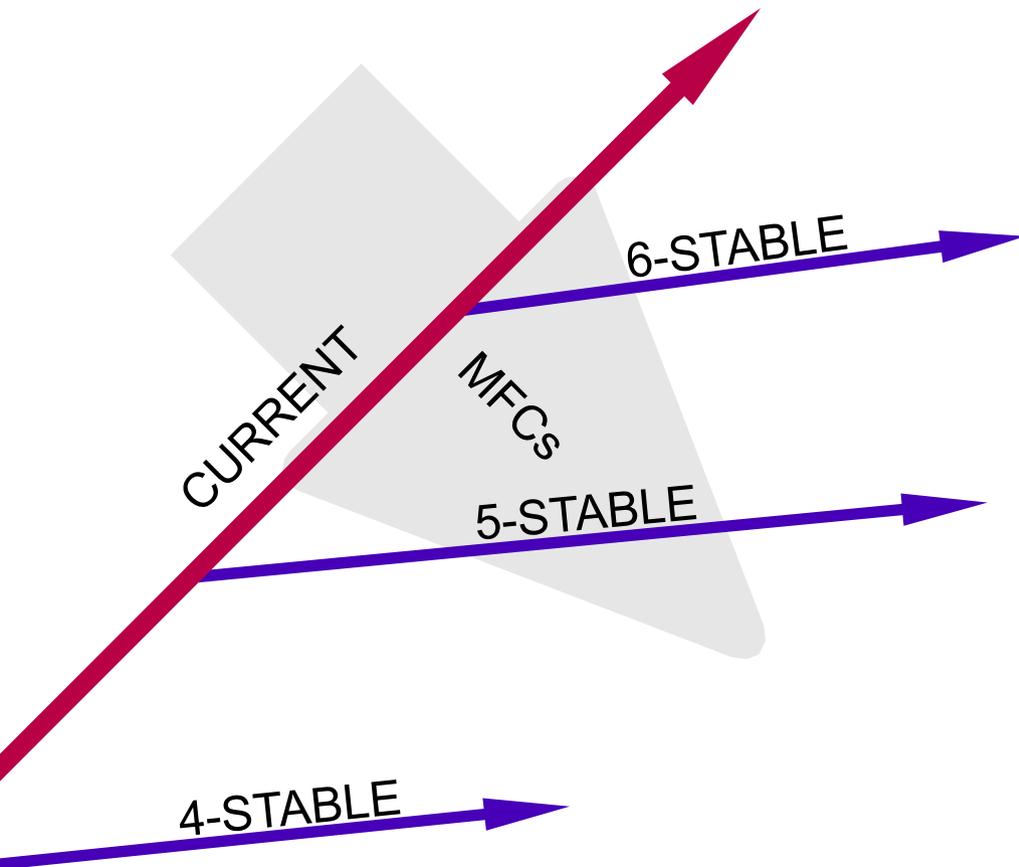
- Simultaneous parallel development

- Divergence based on feature maturity

- "MFC" merges changes from CURRENT to STABLE branches

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FreeBSD Releases

- Three active development branches in CVS
    - 5.x – Major development branch, in maintenance
    - 6.x – Refinement and optimization of 5.x branch
    - 7.x – Active feature development
- Most recent releases FreeBSD 5.5, 6.2
    - Project releases at http://www.FreeBSD.org/
    - CDs/DVDs from several vendors
    - Derived systems (PC-BSD, DesktopBSD, et al).

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FreeBSD Release Cycle

- Most of the time open development

- Release cycle on STABLE branches

  - Code slush

  - Code freeze

  - Beta series, branching

  - Release candidate series

  - Release

  - Errata/Security advisories

- Big "dot zero" releases less frequently

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FreeBSD 7-CURRENT
7.0 due 2007Q4

- MP Scalability
  - 16+ core scalability
  - ULE2 scheduler
  - New threading library
  - Scalable jemalloc
- File systems
  - Sun's ZFS file system
  - GJournal for UFS
- Sun4v

- Security
  - New privilege arch
- Networking
  - Direct dispatch
  - Zero-copy BPF
  - 10gbps optimizations
  - SCTP
- Superpages
- And much more ...

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CVS

- Primary revision control system
  - Most project activity is in CVS
  - 10+ year revision history
  - One commit every 11.8 minutes for last three years
  - Technical limitations becoming more apparent
  - Actually four repositories
    - /home/ncvs – FreeBSD src cvs
    - /home/pcvs – FreeBSD ports cvs
    - /home/projcvs – FreeBSD project cvs
    - /home/dcvs – FreeBSD documentation cvs

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Perforce

- Secondary revision control system

  - Supports heavily branched development

  - FreeBSD developers

  - Guest accounts and project accounts

- Active project include

  - SMPng, TrustedBSD Audit, TrustedBSD MAC

  - TrustedBSD SEBSD, Alan Cox Superpages, uart

  - ARM, Summer of Code, dtrace, Xen, Sun4v

  - GEOM, GJournal, ZFS, CAM locking, netperf, ...

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Revision Control: the Future

- Heavy use of Perforce a symptom of CVS weaknesses

  - Need lightweight branching, history-aware merging

  - Need access control

- Every few years, consider options

  - Cost of migration very high – interrupt development, retrain developers, high risk

- Currently evaluating several of revision control systems to see if any meet requirements

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FreeBSD.org Cluster

- Hosted at Yahoo!

  – Mail servers (hub, mx1, mx2)

  – Distribution (ftp-master, www)

  – Shell access (freefall, builder)

  – Revision control (repoman, spit, ncvsup)

  – Ports cluster (pointyhat, gohans, blades)

  – Test systems (sledge, pluto, panther, beast)

  – Name server (ns0)

  – NetApp filer (dumpster)

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Other Clusters

- Korean Ports Cluster

- allbsd.org
  - Multiprocessor Sun hardware for testing

- Sentex Cluster
  - Security officer
  - Network, SMP performance, storage work

- ISC Cluster
  - ftp.freebsd.org, Coverity, test systems, ports

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Conflict Resolution

- Developers generally characterized by:

  - Independence

  - Cooperation

  - Common sense

- Facilitated by intentional avoidance of overlap

- Strong technical disagreements, personality conflicts, etc, do occur

- When they get out of hand, generally mediated by a member of core

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What Is a Bikeshed, Anyway?

- A very special kind of conflict

- Not specific to FreeBSD, but one of our favorites

- Strong opinions easier to have on unimportant details

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Conclusion

- FreeBSD Project one of the largest, oldest, and most successful open source projects

  - Hundreds of committers, thousands of contributors

  - Millions of lines of code

  - Tens of millions of deployed systems

- Highly successful community model makes it happen

  - Join this community!

- http://www.FreeBSD.org/

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