Distributed versioning for everyone

Nicolas Pouillard

Nicolas.Pouillard@inria.fr

March 20, 2008

Outline

SCM: "Source Code Manager"

- Keeps track of changes to source code so you can track down bugs and work collaboratively.
- Most famous example: CVS
- Numerous acronyms: RCS, SCM, VCS
- DSCM: Distributed Source Code Manager

Purpose

What's the purpose of this presentation

- Show the importance of the distributed feature
- Enrich your toolbox with a DSCM
- Exorcize rumors about darcs
- Show how DSCM are adapted for personal use

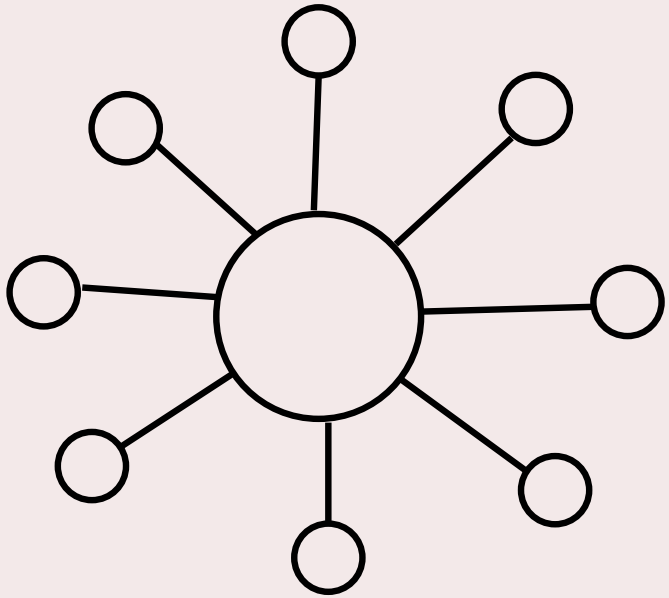
What's **not** the purpose of it

- A flame against other DSCMs
- A precise darcs tutorial
- A real explanation of the Theory of patches

Outline

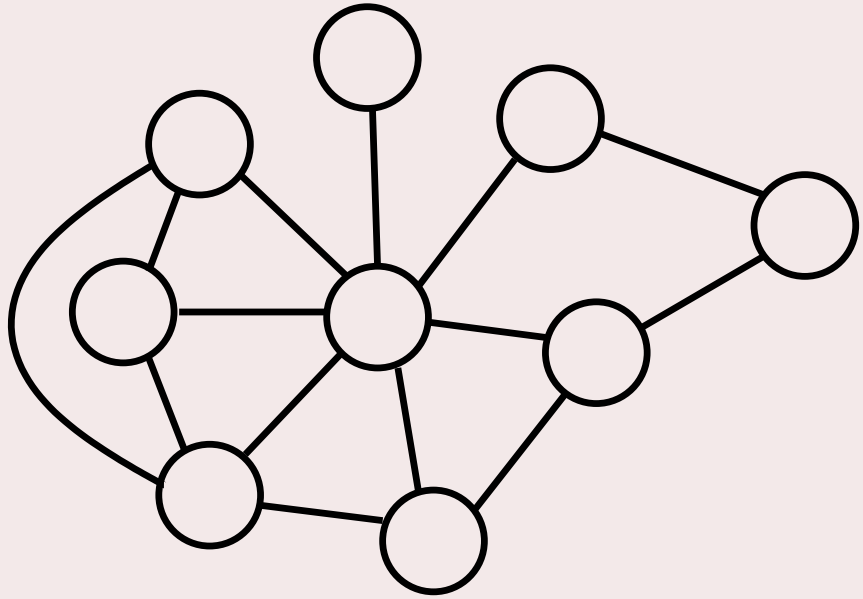
Distributed rather than centralized

Centralized



Examples: CVS, Subversion, Perforce

Distributed



Examples: darcs, Git, Bitkeeper, monotone, arch

Principles

Unify Repositories and Working copies

- Working copies with full history
- Repositories with local changes

Users record/commit in a local branch

- Local branches can be then merged with remote ones
- Branching/Merging is then **forced** to work

Local branches

Branching in a centralized system is morally flawed

- People use branches only when they must
- Branches are public (not discreet)
- That's considered as an advanced usage

Distributed systems make them easy

- Offline commit (no need to be connected)
- Try out an idea (cheap and discreet)
- Polish your work / amend a patch
- Publish with a delay (e.g. end of the work-day)

DSCM are often lighter

- No server to setup
- Make a repository is as easy as "darcs initialize"
- There is no need to "wait for" a center
- No commit rights management needed

DSCM for open source projects

Collaborating to an open source project

- Local branches is a "must have"
- Help to publish only clean and working changes
- Send your patches under **your** name

Work with user contributions

- Maintain an auto-gratification principle
- No need for commit rights (was really a pain)
- Commutation is essential
- Delaying user contributions if needed

Outline

Outline

Why focusing on one of them

- Treat each system in details is too long
- Abstract over DSCM would be too obscure
- Darcs is conceptually simple
- Darcs is certainly the smarter of them

Ideas behind darcs

Distributed

- A simple "egalitarian" distributed model
- "Cherry picking" of changes
- Avoidance of "merge points" (no merge history)

Interactive

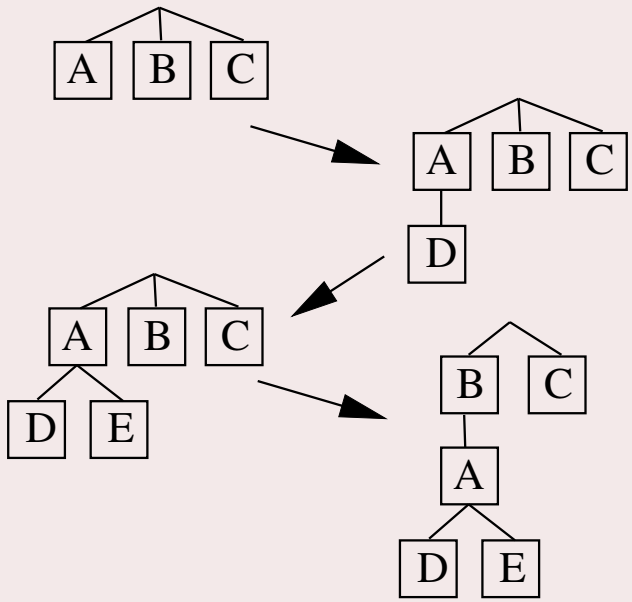
- Efficient and easy to learn
- Improved work flow (e.g. partial records, code review, ...)

Smart

- Based on a unique algebra of patches
- Spontaneous branches
- Commutation of changes

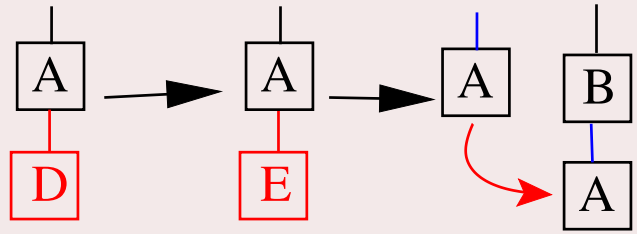
Change-based rather than version-based

Version-based



Examples: Git, Bitkeeper, Monotone, CVS, Subversion

Change-based



Examples: darcs

Darcs terminology

- A change is a logical entity
- A patch is a description of a change
- The state of a repository is defined by its set of changes
- A set of changes is stored as a sequence of patches

Notation

- A change is represented as a capital letter: A
- A patch is represented by a capital letter with possibly primes and/or a subscript: A, A', A_1
- Sometimes the state (or context) before and after a patch is represented by lowercase superscripts: ${}^{o}A^{a}$

The state of a repository is defined by a **set** of **changes**.

The repository is represented by a **sequence** of **patches**.

Outline

Some primitive patches

- `addfile` f: Create the empty file f
- `rmdir` d: Remove the empty directory d
- `move` x y: Move/rename the file/directory x into y
- `hunk`: Change the contents of a file

```
hunk "foo.txt" 42
- the old lines has been
- removed.
+ and replaced by this one
```

However the theory is independent of its primitives

Each patch is invertible

Definition

$$\texttt{invert}\ {}^{o}A^{a} = {}^{a}A^{-1o}$$

Property

$$\forall\ x\ .\ \texttt{invert}\ (\texttt{invert}\ x) = x$$

Examples

- $\texttt{invert}\ (\texttt{addfile}\ f) = \texttt{rmfile}\ f$
- $\texttt{invert}\ (\texttt{move}\ x\ y) = \texttt{move}\ y\ x$
- $\texttt{invert}\ (\texttt{hunk}\ f\ \mathit{line}\ \mathit{old}\ \mathit{new}) = \texttt{hunk}\ f\ \mathit{line}\ \mathit{new}\ \mathit{old}$
- $\texttt{invert}\ (A :> B) = (\texttt{invert}\ B) :> (\texttt{invert}\ A)$

Consequence: While `move` is easy, `copy` hardly make sense

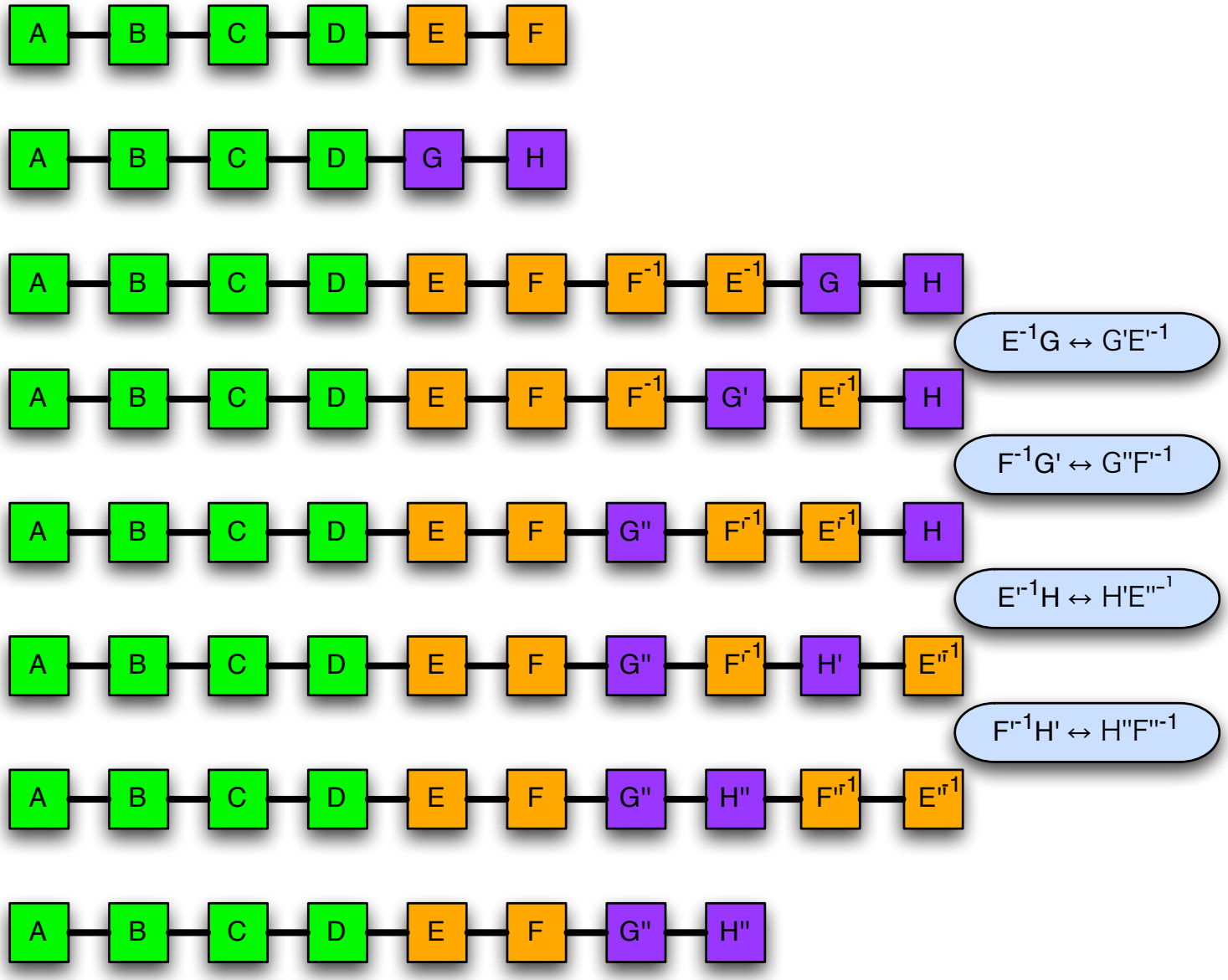
Independent changes ⇒ commuting patches

$$ {}^{o}A^{a}B^{b} \leftrightarrow {}^{o}B_1^{c}A_1^{b} $$

Examples

- Hunks on different files trivially commute
- Hunks commute with moves
- Hunks on different parts of a file commute (output patches have different line numbers)

Illustrated naive merging...


A B C D E F
A B C D G H
A B C D E F F-1 E-1 G H
E-1G ↔ G'E'-1
A B C D E F F-1 G' E'-1 H
F-1G' ↔ G"F'-1
A B C D E F G" F'-1 E'-1 H
E'-1H ↔ H'E"-1
A B C D E F G" F'-1 H' E"-1
F'-1H' ↔ H"F"-1
A B C D E F G" H" F"-1 E"-1
A B C D E F G" H"

Outline

Darcs for small projects

- A research paper
- A prototype implementation
- A small module/library
- Configuration files
- Personal web page
- More to imagine...

The bare minimum

`initialize`	Initialize a new source tree as a darcs repository
`add`	Add one or more new files or directories
`record`	Save local changes as a patch
`mv`	Move/rename one or more files or directories
`whatsnew`	Display local/unrecorded changes

Handy operations

`revert`	Revert to the recorded version (not always doable)
`unrevert`	Undo last revert (unless if changes after the revert)
`rollback`	Record a new patch reversing some changes

Handy operations

`revert`	Revert to the recorded version (not always doable)
`unrevert`	Undo last revert (unless if changes after the revert)
`rollback`	Record a new patch reversing some changes

Handy operations

`revert`	Revert to the recorded version (not always doable)
`unrevert`	Undo last revert (unless if changes after the revert)
`rollback`	Record a new patch reversing some changes

Handy operations

`revert`	Revert to the recorded version (not always doable)
`unrevert`	Undo last revert (unless if changes after the revert)
`rollback`	Record a new patch reversing some changes

Handy operations

`revert`	Revert to the recorded version (not always doable)
`unrevert`	Undo last revert (unless if changes after the revert)
`rollback`	Record a new patch reversing some changes

`revert ; unrevert` $\approx$ `id`

Overriding unpublished changes

`amend-record`	Replace a patch with a better version
`unrecord`	Remove patches wo/ changing the working copy
`obliterate`	Delete selected patches from the repository

Overriding unpublished changes

`amend-record`	Replace a patch with a better version
`unrecord`	Remove patches wo/ changing the working copy
`obliterate`	Delete selected patches from the repository

Overriding unpublished changes

`amend-record`	Replace a patch with a better version
`unrecord`	Remove patches wo/ changing the working copy
`obliterate`	Delete selected patches from the repository

Overriding unpublished changes

`amend-record`	Replace a patch with a better version
`unrecord`	Remove patches wo/ changing the working copy
`obliterate`	Delete selected patches from the repository

Overriding unpublished changes

`amend-record`	Replace a patch with a better version
`unrecord`	Remove patches wo/ changing the working copy
`obliterate`	Delete selected patches from the repository

- `amend-record` $\approx$ `unrecord ; record`
- `obliterate` $\approx$ `unrecord ; revert`

Towards advanced patch types

`replace` Replace a token with a new value for that token

Looking in the past

`changes`	Give a summary of the repository history
`annotate`	Display which patch last modified something
`diff`	Create a diff between versions of the repository
`dist`	Create a distribution tarball
`trackdown`	Locate the most recent version lacking an error
`show`	Show information which is stored by darcs

Outline

Moving patches around

`pull`	Apply patches from another repository to this one
`push`	Apply patches from this repository to another one
`get`	Create a local copy of another repository
`put`	Make a copy of the repository
`send`	Send (by email) a bundle of one or more patches
`apply`	Apply patches (from an email) to the repository

Moving patches around

`pull`	Apply patches from another repository to this one
`push`	Apply patches from this repository to another one
`get`	Create a local copy of another repository
`put`	Make a copy of the repository
`send`	Send (by email) a bundle of one or more patches
`apply`	Apply patches (from an email) to the repository

Moving patches around

`pull`	Apply patches from another repository to this one
`push`	Apply patches from this repository to another one
`get`	Create a local copy of another repository
`put`	Make a copy of the repository
`send`	Send (by email) a bundle of one or more patches
`apply`	Apply patches (from an email) to the repository

Moving patches around

`pull`	Apply patches from another repository to this one
`push`	Apply patches from this repository to another one
`get`	Create a local copy of another repository
`put`	Make a copy of the repository
`send`	Send (by email) a bundle of one or more patches
`apply`	Apply patches (from an email) to the repository

Moving patches around

`pull`	Apply patches from another repository to this one
`push`	Apply patches from this repository to another one
`get`	Create a local copy of another repository
`put`	Make a copy of the repository
`send`	Send (by email) a bundle of one or more patches
`apply`	Apply patches (from an email) to the repository

Moving patches around

`pull`	Apply patches from another repository to this one
`push`	Apply patches from this repository to another one
`get`	Create a local copy of another repository
`put`	Make a copy of the repository
`send`	Send (by email) a bundle of one or more patches
`apply`	Apply patches (from an email) to the repository

Moving patches around

`pull`	Apply patches from another repository to this one
`push`	Apply patches from this repository to another one
`get`	Create a local copy of another repository
`put`	Make a copy of the repository
`send`	Send (by email) a bundle of one or more patches
`apply`	Apply patches (from an email) to the repository

Moving patches around

`pull`	Apply patches from another repository to this one
`push`	Apply patches from this repository to another one
`get`	Create a local copy of another repository
`put`	Make a copy of the repository
`send`	Send (by email) a bundle of one or more patches
`apply`	Apply patches (from an email) to the repository

- `get` *src dst* $\approx$ `initialize` *src* `;` `cd` *src* `&&` `pull` *dst*
- `put` *dst* $\approx$ `initialize` *dst* `;` `push` *dst*
- `push` *dst* $\approx$ `send` *dst* `;` `cd` *dst* `&&` `apply`

Branching and merging

Branching is as easy as copying all patches

```
$ darcs get foo-stable foo-with-feature-A
```

Merging is as easy as {pull,push}ing things

```
$ cd foo-with-feature-A
$ darcs pull ../foo-stable
```

Tagging your repository (darcs tag)

A "tag" patch is:

- A change with no effect
- Transitively depends on all patches
- Really depends only on non tagged patches

Tagging quite often is a good practice

- Tag (some/only) versions that pass all tests
- Tag pre-releases and releases

Drawback of tagging

Freeze commutations (patches under a tag cannot cross the tag)

darcs + tagging like crazy ≈ git

```
$ git commit = darcs record ; darcs tag -m <SHA1>
```

- Enforce the history
- Enforce the order of patches
- Loose commutativity (manually hacked with git rebase)

Fancy features

- Take the union: pull another repository
- Extract a sub part: pull interactively only what's needed

Outline

Working with others

- Just replace pathnames by URLs (http, ssh)
- Use send/apply for email based contributions

Outline

When conflicts happen

Two patches conflicts

- they are parallel patches ($A \vee B$)
- they don't commute ($A\ B^{-1} \nleftrightarrow B'\ A'^{-1}$)

Conflict example

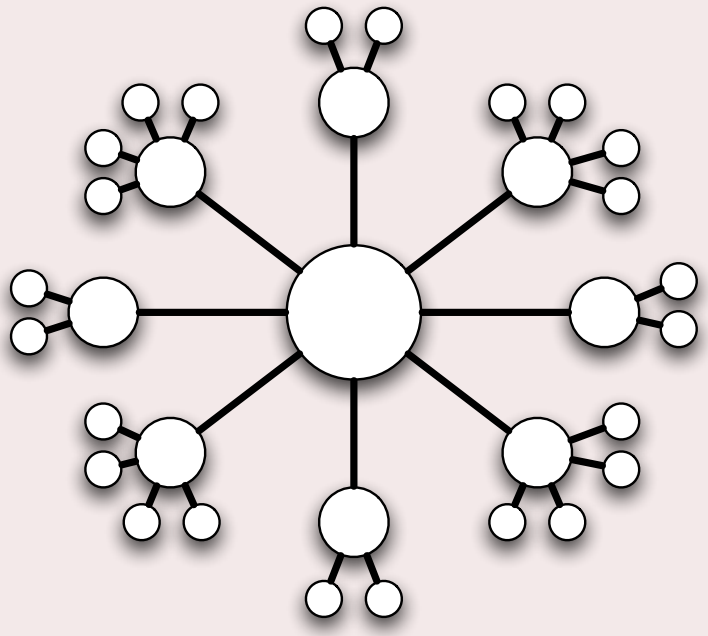
```
hunk "foo.txt" 42
- # TODO
+ # FIXED

hunk "foo.txt" 42
- # TODO
+ # DONE
```

Resolving conflicts

- When two patches conflicts one add a third one
- By depending on the conflicting patches it tells what to do
- Resolutions patches should be shared as much as possible

Avoiding conflicts

Typical DVCS usage



Recipe

- Pull often
- Amend local patches to resolve conflicts
- Push/send clean patches

Is darcs slow?

- Performances are due to its algorithms not its implementation
- Darcs algorithms provide more power/flexibility
- Completely usable for day to day commands
- Can be really slow on hard requests
- Darcs2 has made great progress
- Darcs2 reports progress to the user
- Darcs2 handles the conflict resolution problem

Are DSCM slow or greedy?

- Full history means bigger/slower copies/gets
- Hard links in the repository
- More network friendly than CVS/SVN
- Darcs2 partial repositories could help

Outline

Conclusion and questions

So, convinced?

Resources

- "The Monad Reader", issue 9 by Jason Dagit
- "Implementing the darcs patch formalism ...and verifying it" by David Roundy
- The darcs website `http://darcs.net`
- The darcs help