Software <u>Configuration</u> Management

Slides derived from Dr. Sara Stoecklin's notes and various web sources.

What is SCM?

SCM goals

- Manage the changes to documents, programs, files, etc.
- Track history
- Identify person responsible for each change, and reasons
- Recover (roll back to) previous versions as necessary
- Maintain sets of compatible versions of files (configurations)

Several related concepts & terms

- Source code vs. configuration management
  - both called SCM
- Revision control ≈ version control
- Web content management
- Work flows

Definition according to Wiki

Configuration management is the management of features and assurances through control of changes made to hardware, software, firmware, documentation, test, test fixtures and test documentation of an system, throughout the development and operational life of a system.

Source Code Management or *revision control* is part of this.

Definition According to Dennis

Configuration and change management is the tracking of the state of the artifacts (hardware, software, firmware, documentation, test, test fixtures and test documentation of an system) throughout the development of a system.

Configuration Management Defined

The management and control of all any changes made to any and all features of the software development activity. This includes hardware, software, documentation, and firmware.

Configuration management can be done with a tool. These tools range in price from $0 to $400,000. It depends on how many features you wish to manage and how well you want to manage them.

Why do we care?

Remember Apollo 13.

If a change needs to be made to ANY artifact then when you put them all together again you had better make it right. Suppose you have a programming error and need to change it, recompile and use that software.

What version of the hardware did you use for the original? What version of the OS, DB, compiler? What version of the file management software? All that should be the same to recompile. So we must manage.

Why do we care?

Suppose we change requirements and get a new use case diagram. Do other things have to change? Will we have more actors, attributes, screen?. So even when the documentation of the system changes as it evolves, we must track that, too.

What are the artifacts?

Hardware – ANY hardware that is used by the system.

Software – system software (OS, DB, Compiler, etc), supporting software (sorters, mergers, utilities), application software (you wrote or you use).

Firmware – ANY firmware used by the system.

Documentation – deliverables for development, documentation maintained for the operation of the system, etc.

Configuration Management Includes

- Change management - of changes to the specifications of a potential software system
- Documentation management –of all documentation including defects, specification, testing, purchasing, emails, memos, agendas…every single documentation detail
- Hardware/firmware configuration management - of all the hardware and firmware.
- Source code management –of changes to the source code including the application code, operating system, compilers, utilities, database management system, communication system, middleware, etc.

Configuration Management Standards

e.g.

IEEE Std. 828-1998 IEEE Standard for Software Configuration Management Plans

ANSI/EIA-649-1998 National Consensus Standard for Configuration Management

MIL-STD-973 Military Standard for Configuration Management[1] (cancelled, but still good reference)

GEIA Standard 836-2002 Configuration Management Data Exchange and Interoperability

Source Code Management

- One of the important parts of configuration management
- For any development project you need to have a SCM plan
- SCM is closely connected with <u>team workflow</u>
  - Workflow defines how SCM is done
  - How tools are used

Complicating factors for SCM

- Multiple versions
- Multiple branches (e.g., development, bug fix, old releases)
- Multiple authors
- Concurrent activities
- Geographical distribution
- Disk crashes, human errors

SCM Model Differences

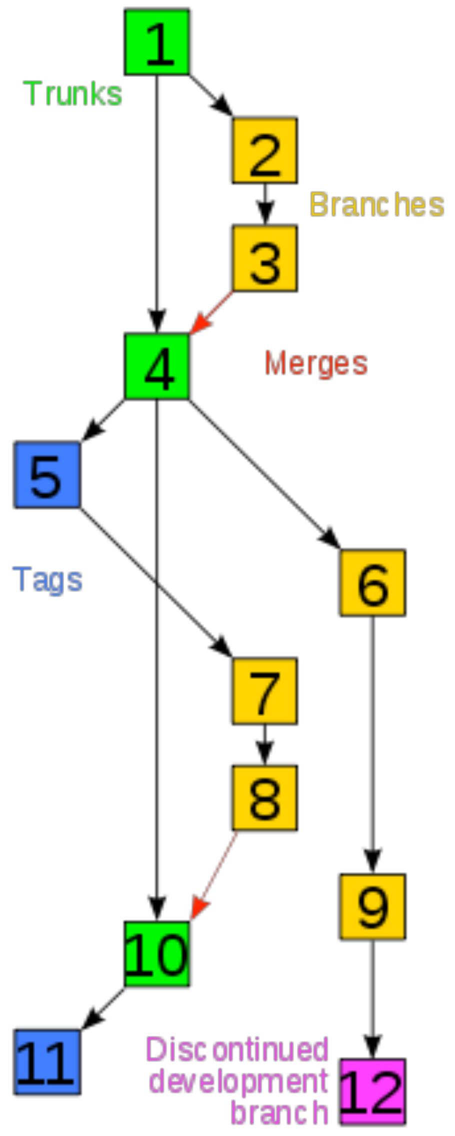
- Centralized vs. Distributed
- Pushed vs. pulled updates
- Handling of concurrent updates
  - Atomic commit operations (transactions)
  - File locking
  - Version merging

There are many SCM tools

- RCS
- CVS
- Subversion (svn)
- Git
- Mercurial (hg)
- Bazaar (bzr)
- … many more

Key terms and concepts

- File vs. configuration
- Version/revision numbers
- Timestamps
- Releases
- Repository
- Working copy, or sandbox
- Baseline/trunk/mainline/master
- Branches/forks
- Change list or patch

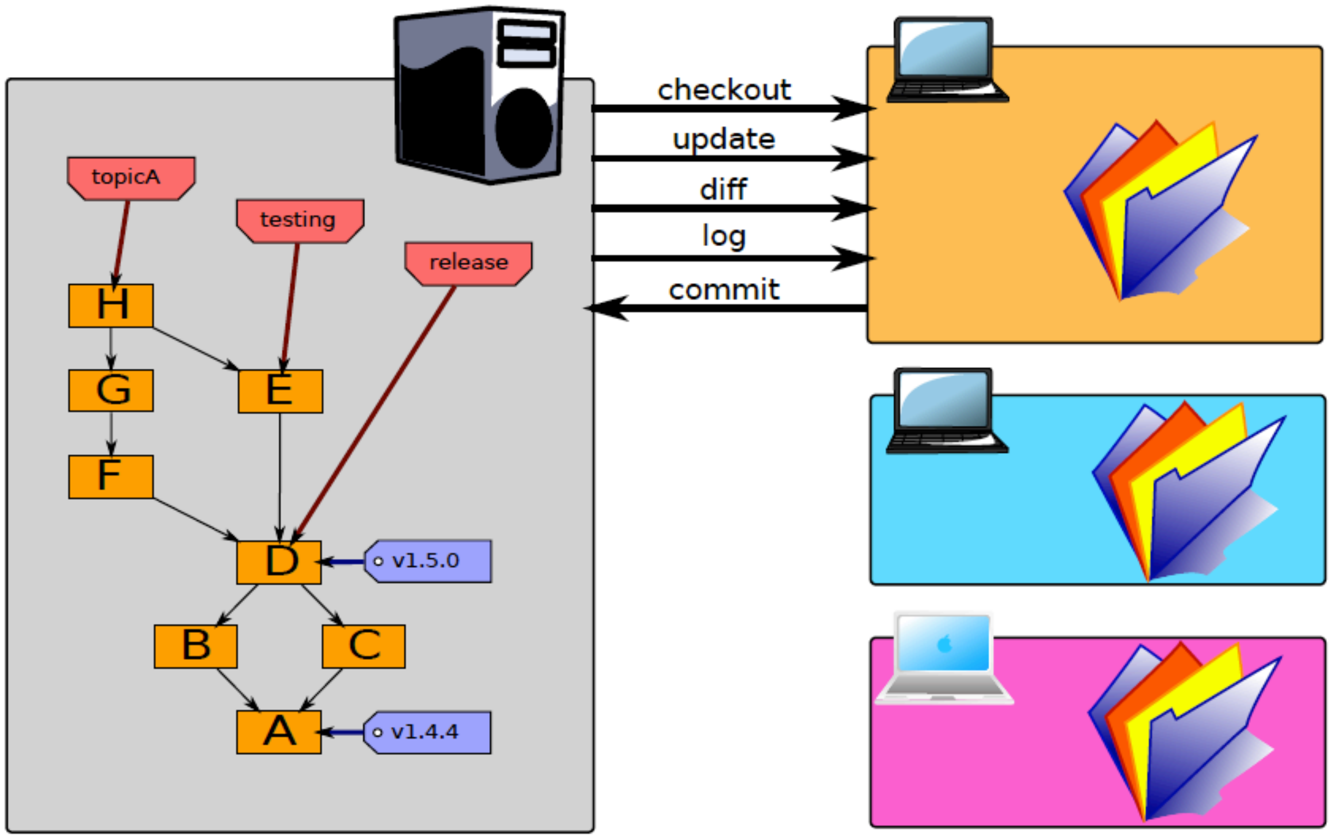


More terms and concepts

- "Checkout" has multiple meanings
  - Get local working copy (or make it visible?)
  - Locked, or not?
  - Configuration versus file
- Export/import
- Commit
- Conflict (superficial, or deep)
- Merge
- Tags

Centralized vs. distributed SCM models

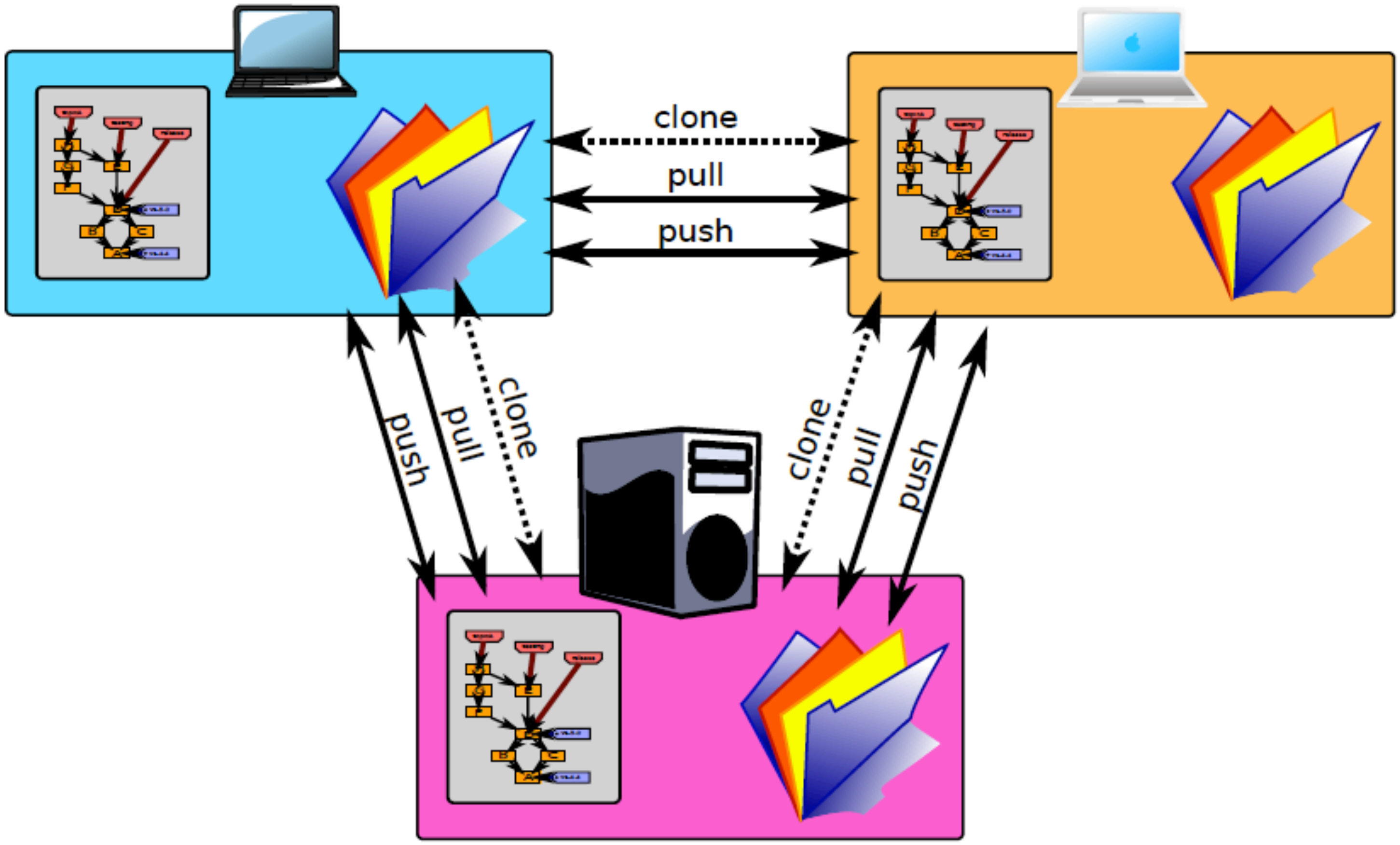
Centralized SCM



Operations require server
- single point of failure
- bottleneck

http://edgyu.excess.org/git-tutorial/2008-07-09/intro-to-git.pdf

Decentralized SCM

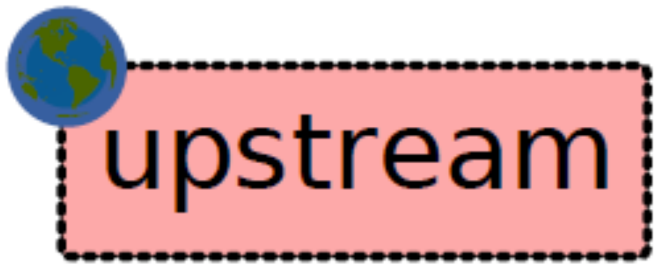


Anyone can be a server

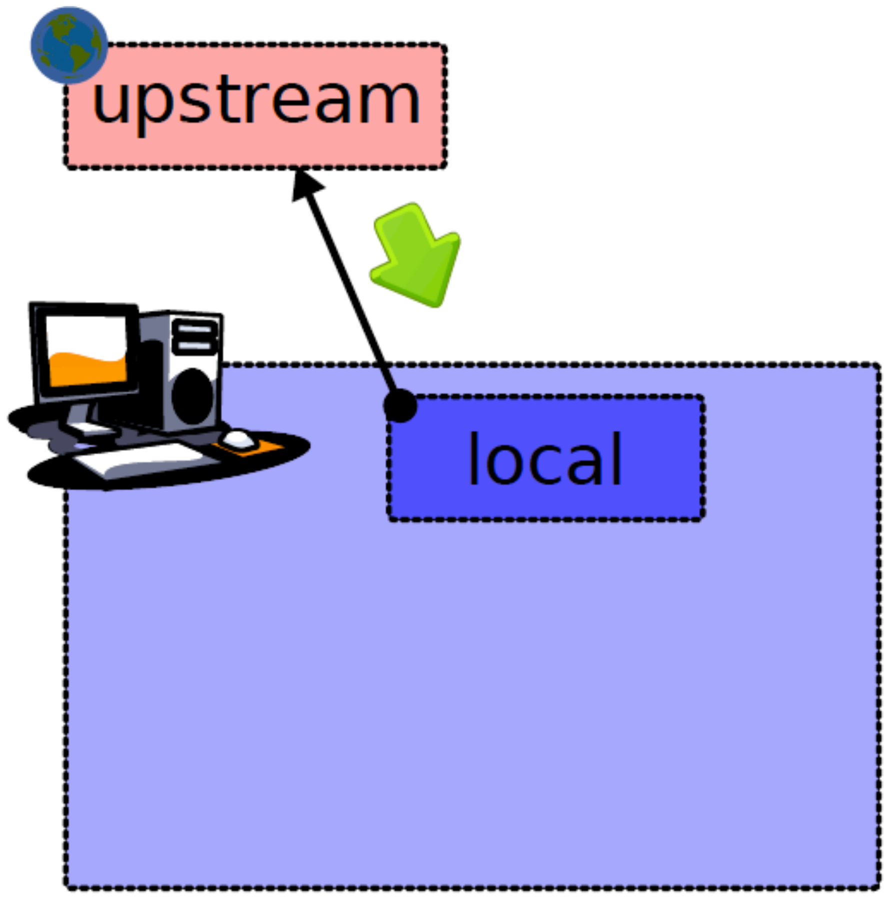
http://edgyu.excess.org/git-tutorial/2008-07-09/intro-to-git.pdf

How decentralized SCM works.

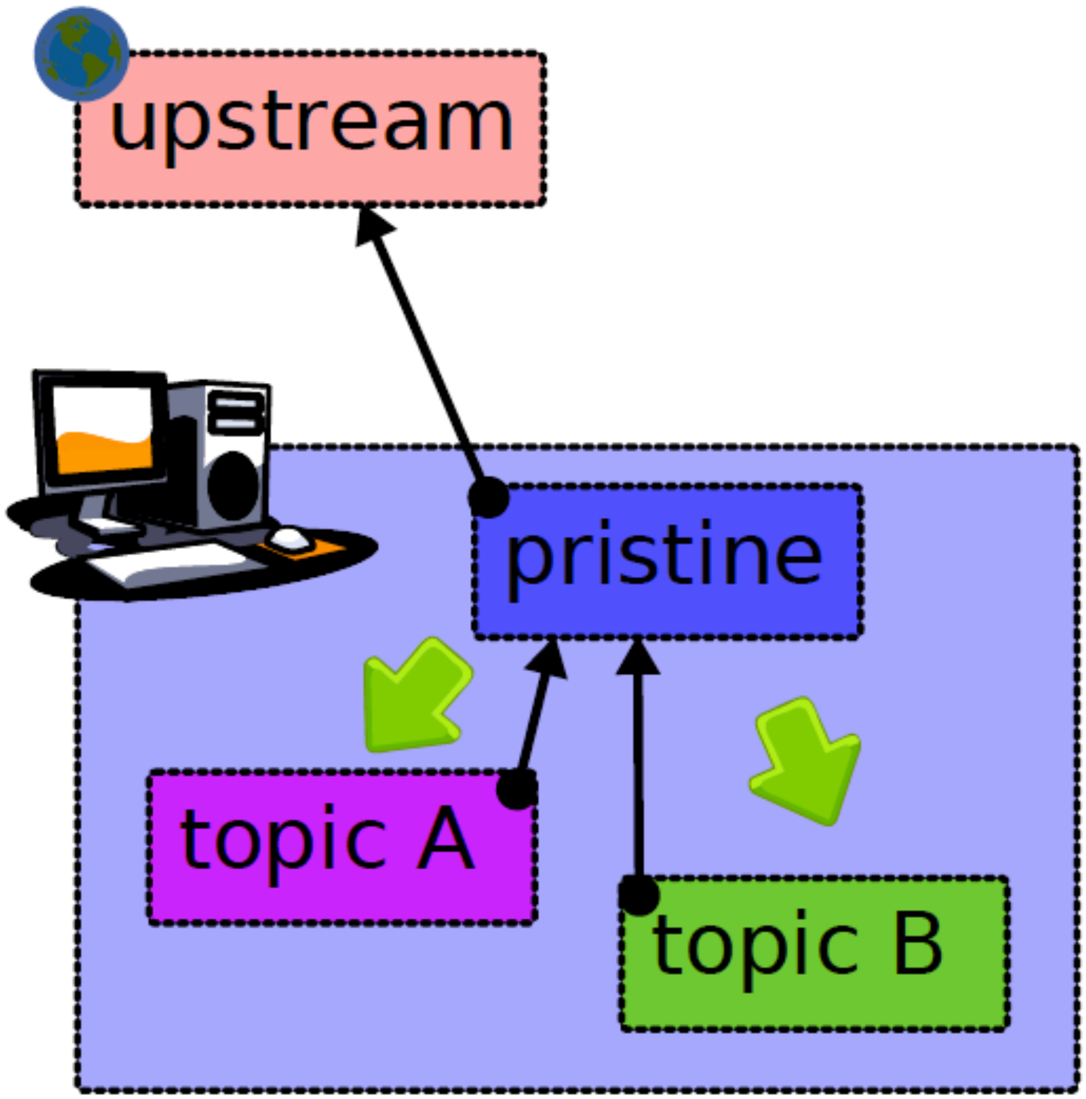
Start with a global repository



Clone it



Can make cheap local clones via links



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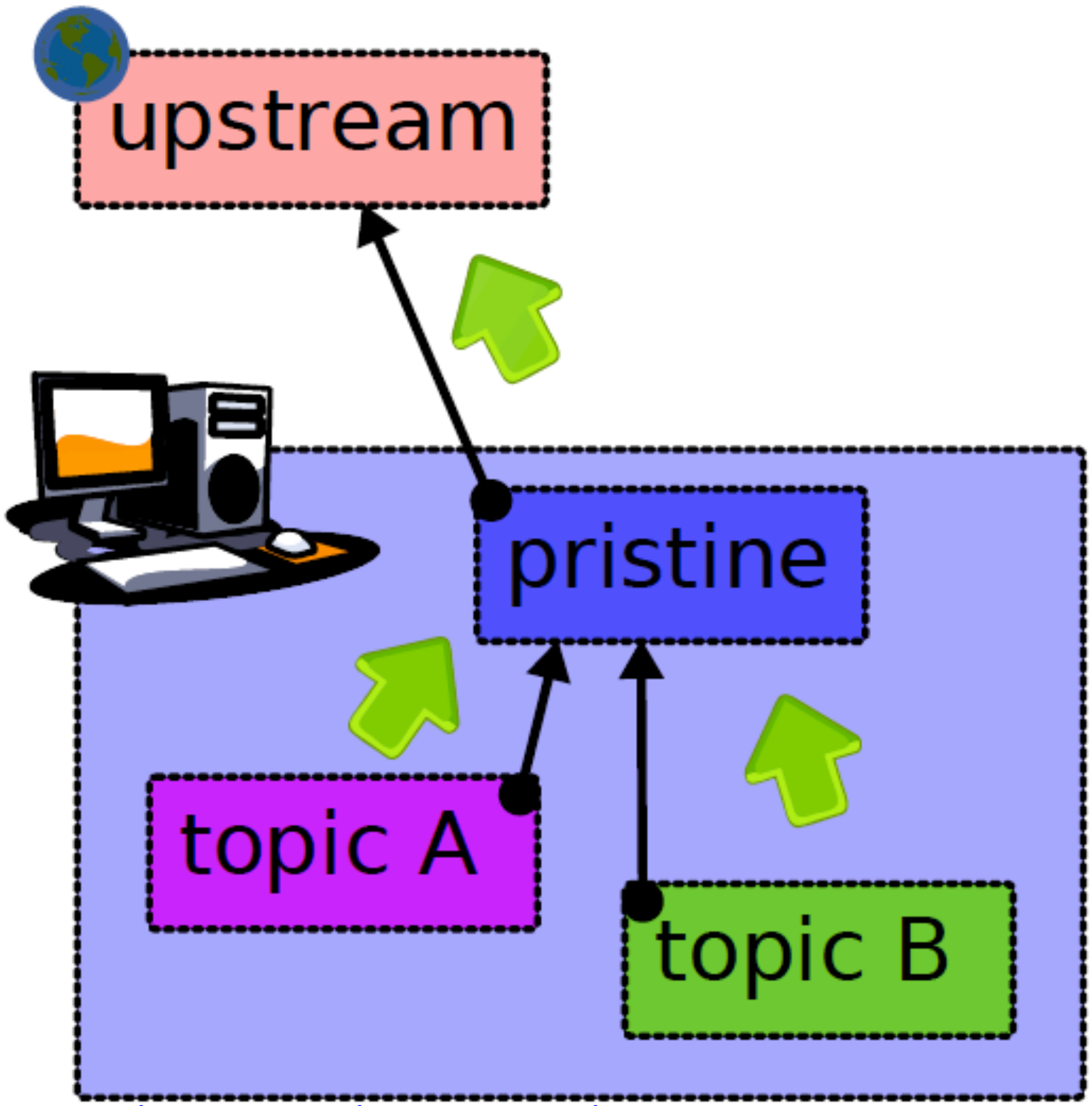
Changes can be pushed back upstream



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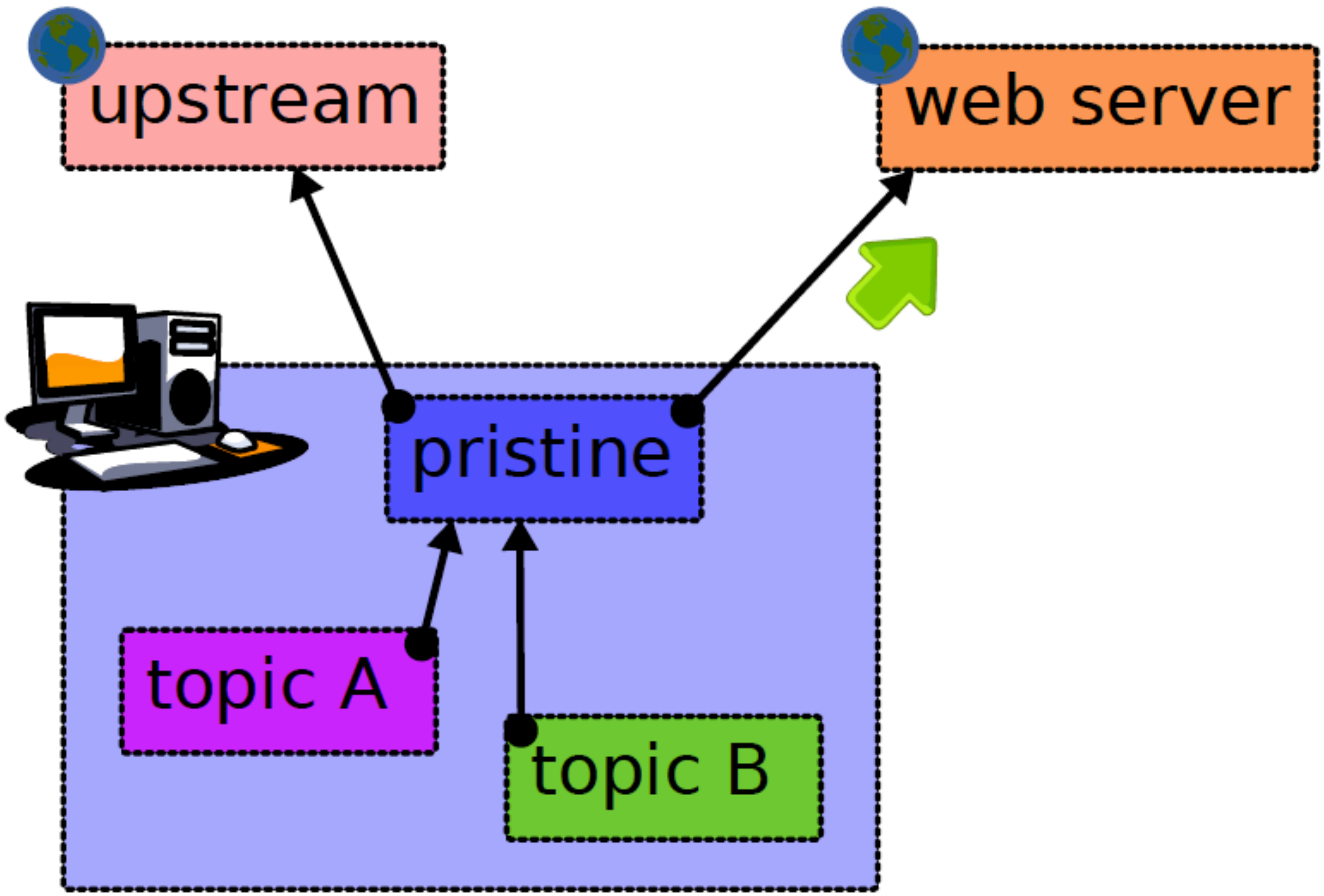
published to web



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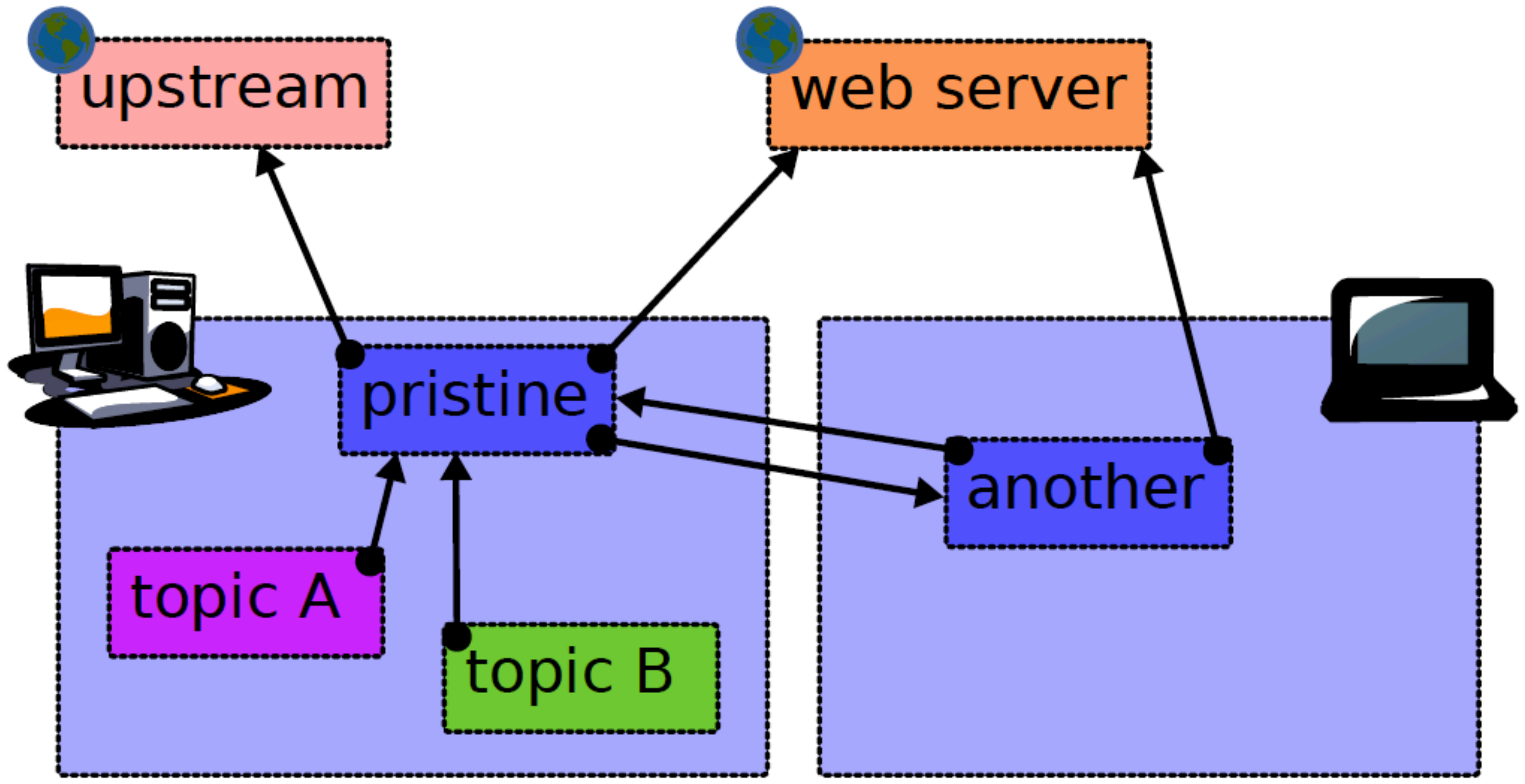
or shared with trusted peers



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Benefits of decentralization

- Non-intrusive micro-commits
- Detached operation (off net)
- No single point of failure
- Backups are trivial
- Very flexible
- … ?

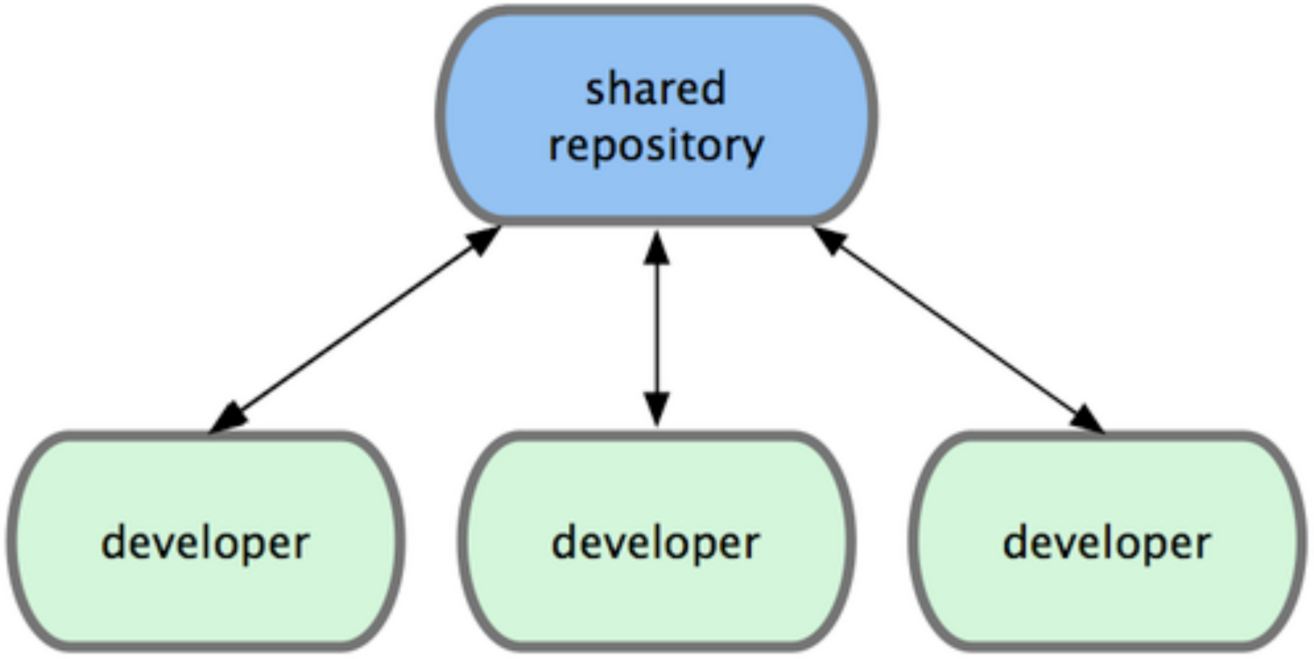
Problems with decentralization

- No "locking"
- No single authoritative version
- Relies on clock synchronization
- Requires greater discipline, imposed by team <u>workflow rules</u>

Example workflow models

Suitable for use with Git or other distributed SCM tool.

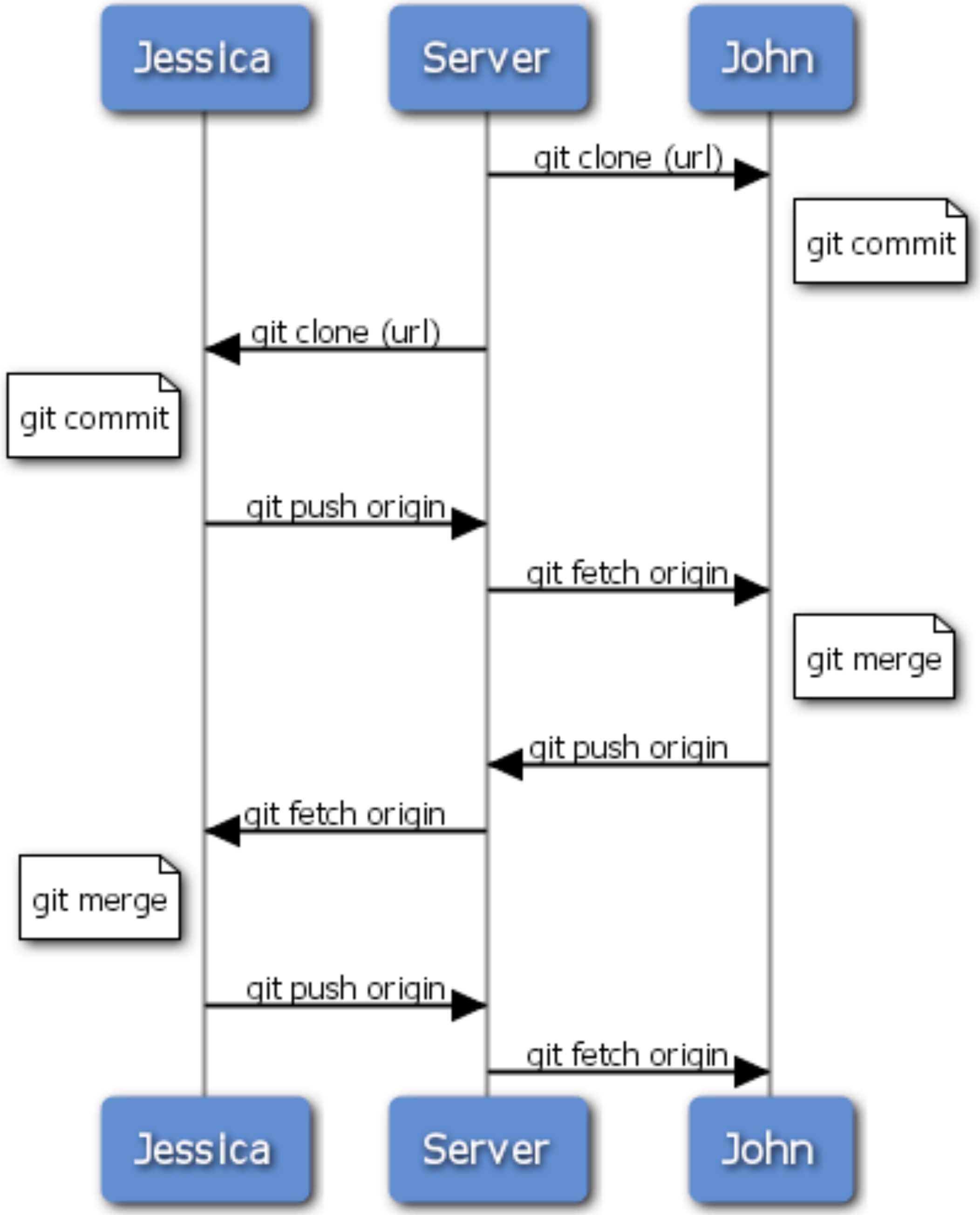
Agile workflow



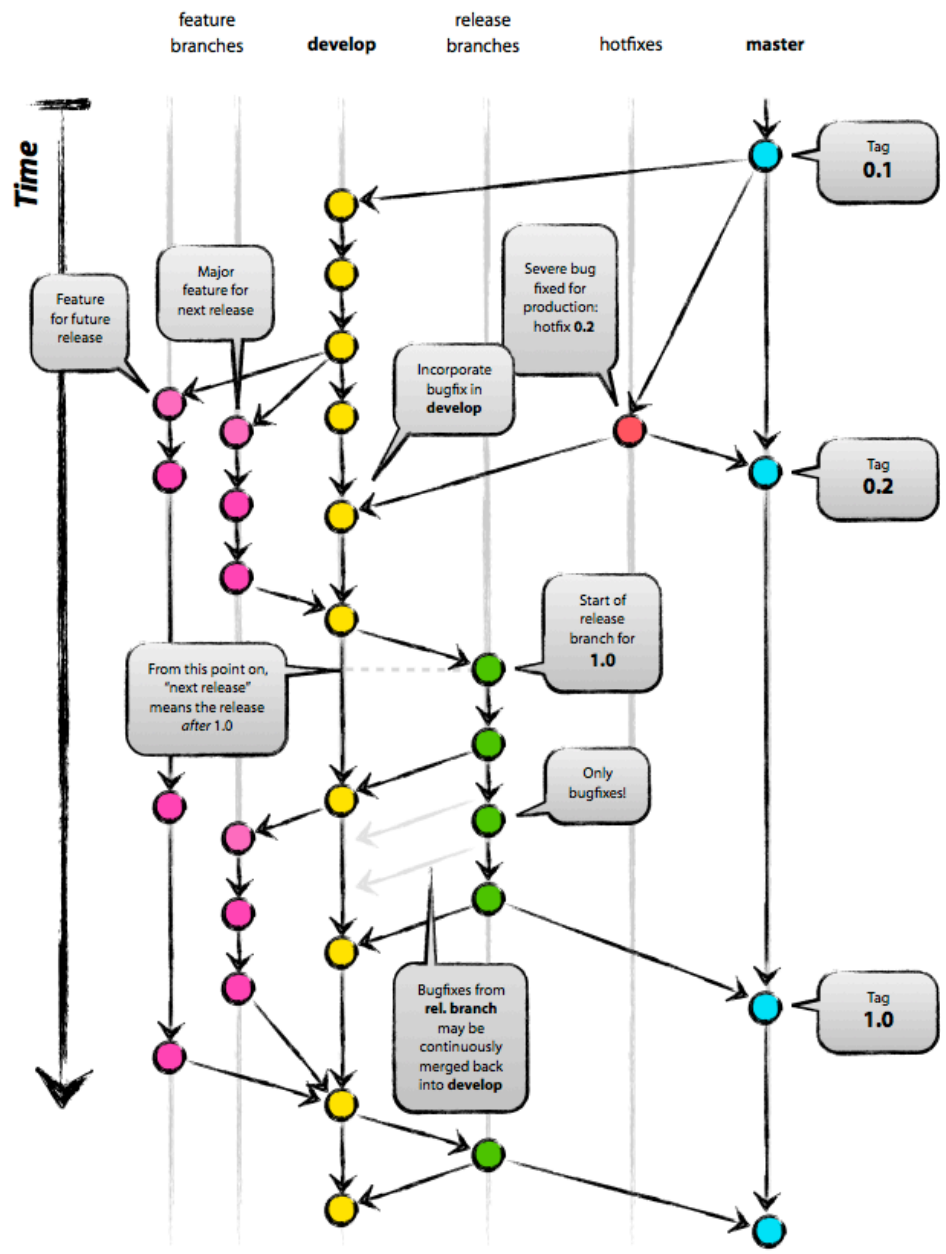
All developers are equal, all push changes to same repository.
Repository is always up to date with the current “wave front”.

tp://progit.org/book/ch5-1.html

UML Sequence Diagram
for an Agile team.

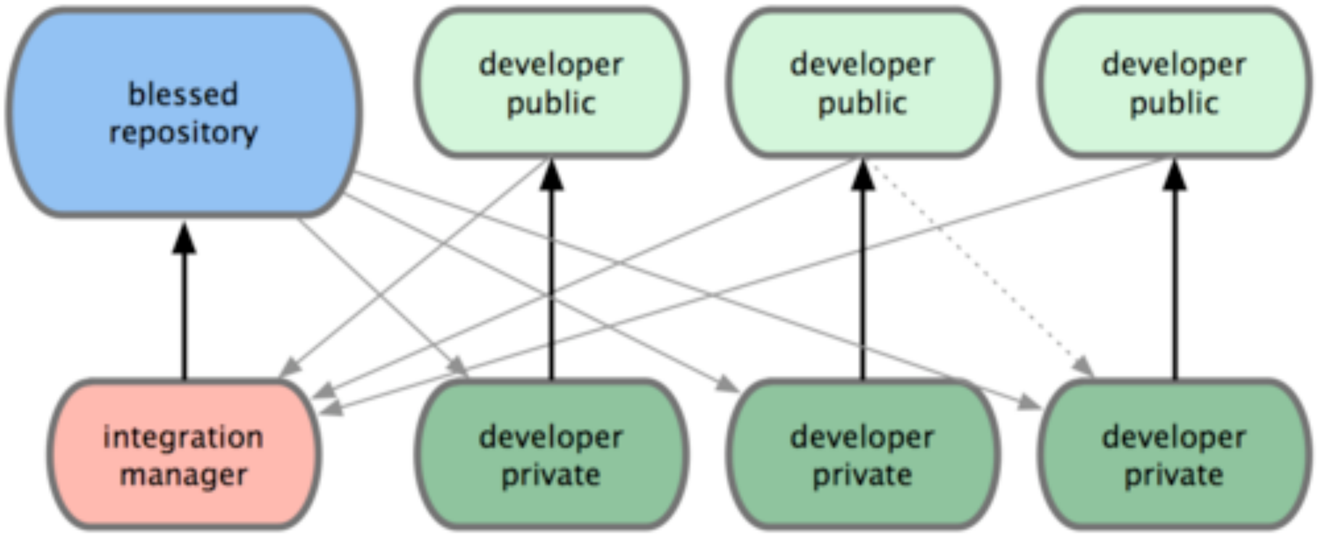


Agile workflow


feature branches
develop
release branches
hotfixes
master
Time
Tag 0.1
Severe bug fixed for production: hotfix 0.2
Major feature for next release
Feature for future release
Incorporate bugfix in develop
Tag 0.2
Start of release branch for 1.0
From this point on, "next release" means the release *after* 1.0
Only bugfixes!
Tag 1.0
Bugfixes from rel. branch may be continuously merged back into develop

http://nvie.com/wp-content/uploads/2009/12/Screen-shot-2009-12-24-at-11.32.03.png

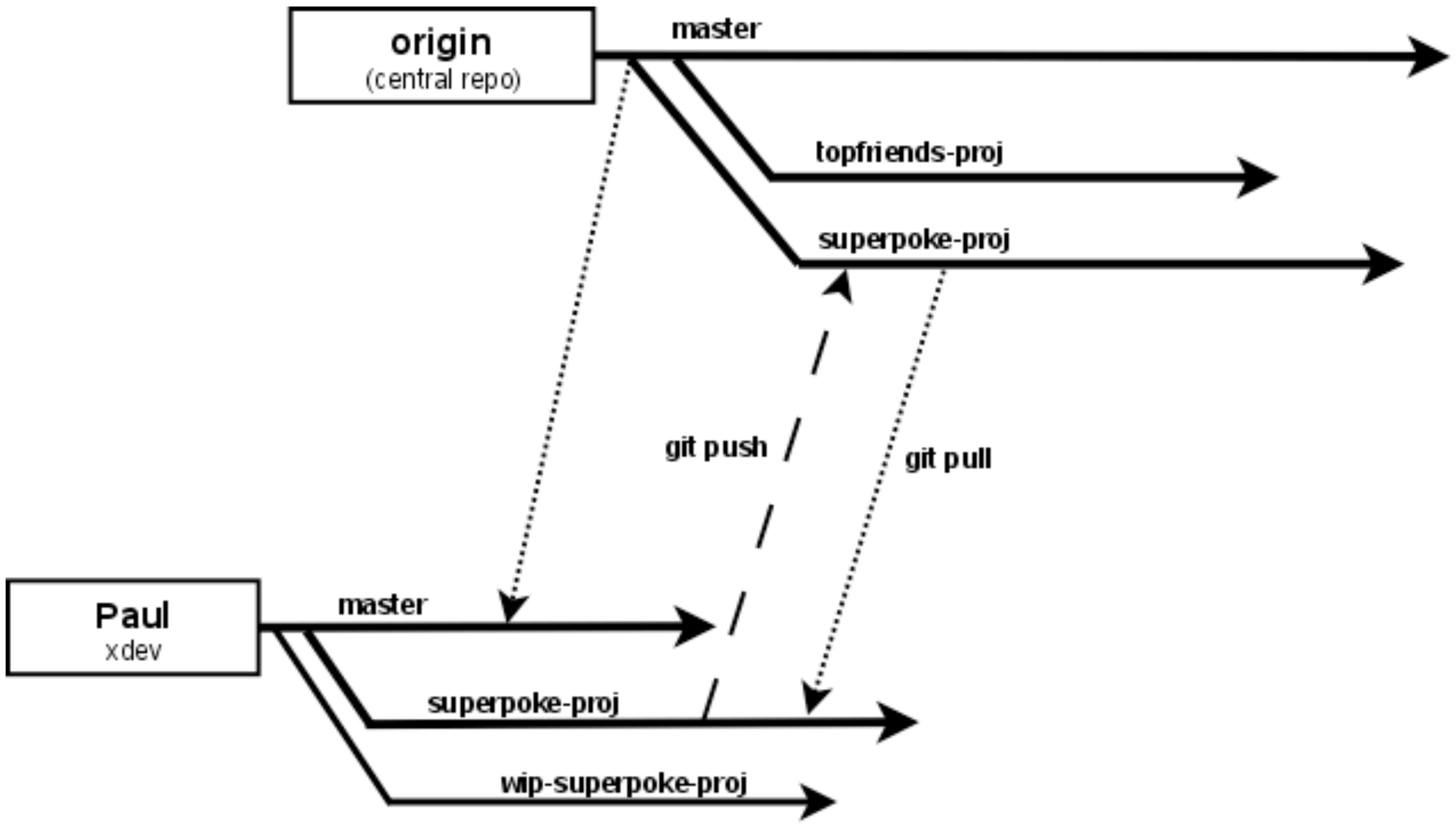
Managed repository



Only one person can push changes to the blessed repository.
Means less chance for accidents, but we now have a bottleneck.

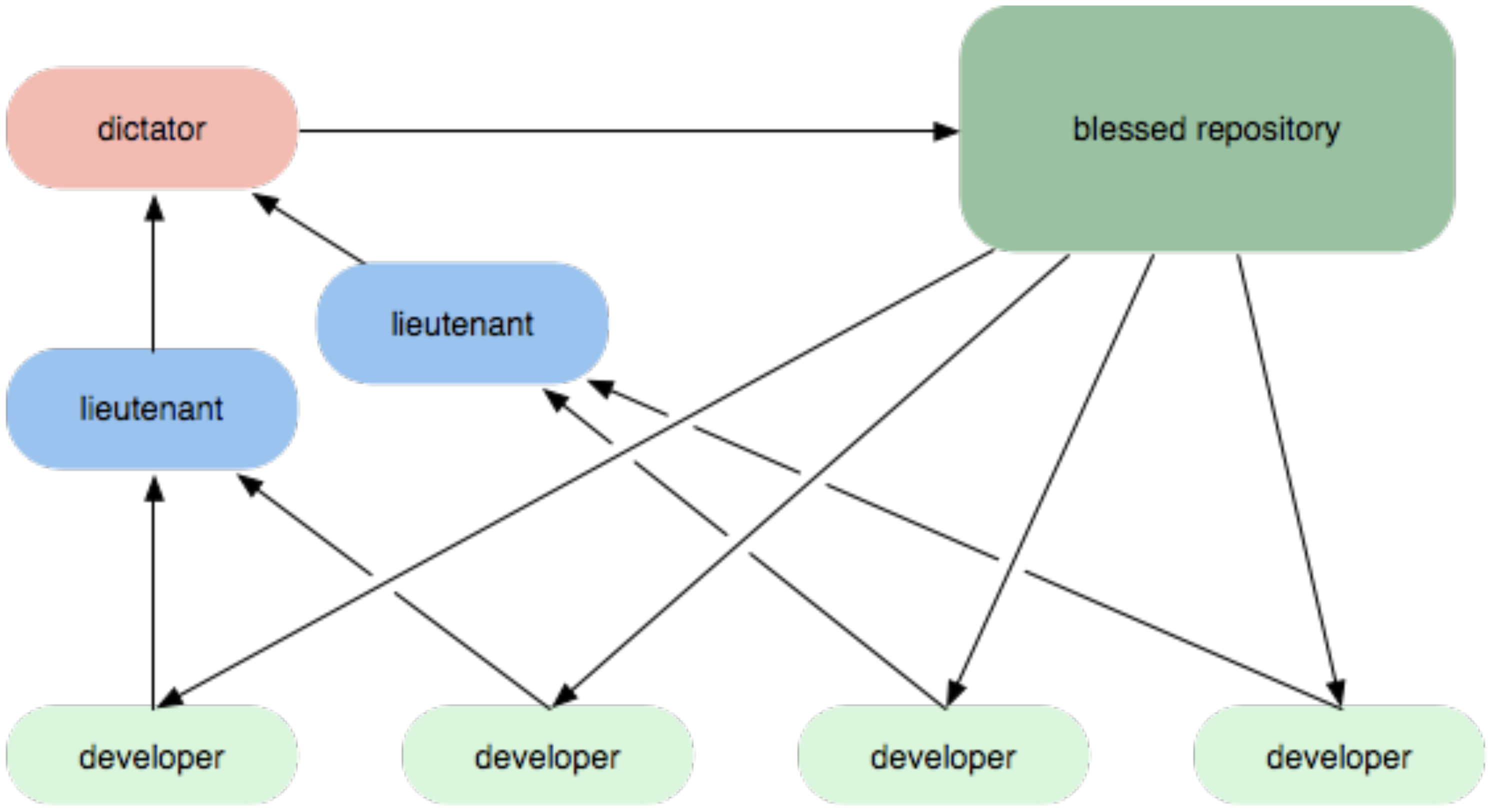
tp://progit.org/book/ch5-1.htm

An alternate way of sharing a repository, using branches.



http://agentdero.cachefly.net/unethicalblogger.com/images/basic_slide_workflow.png

Linux-like hierarchical model

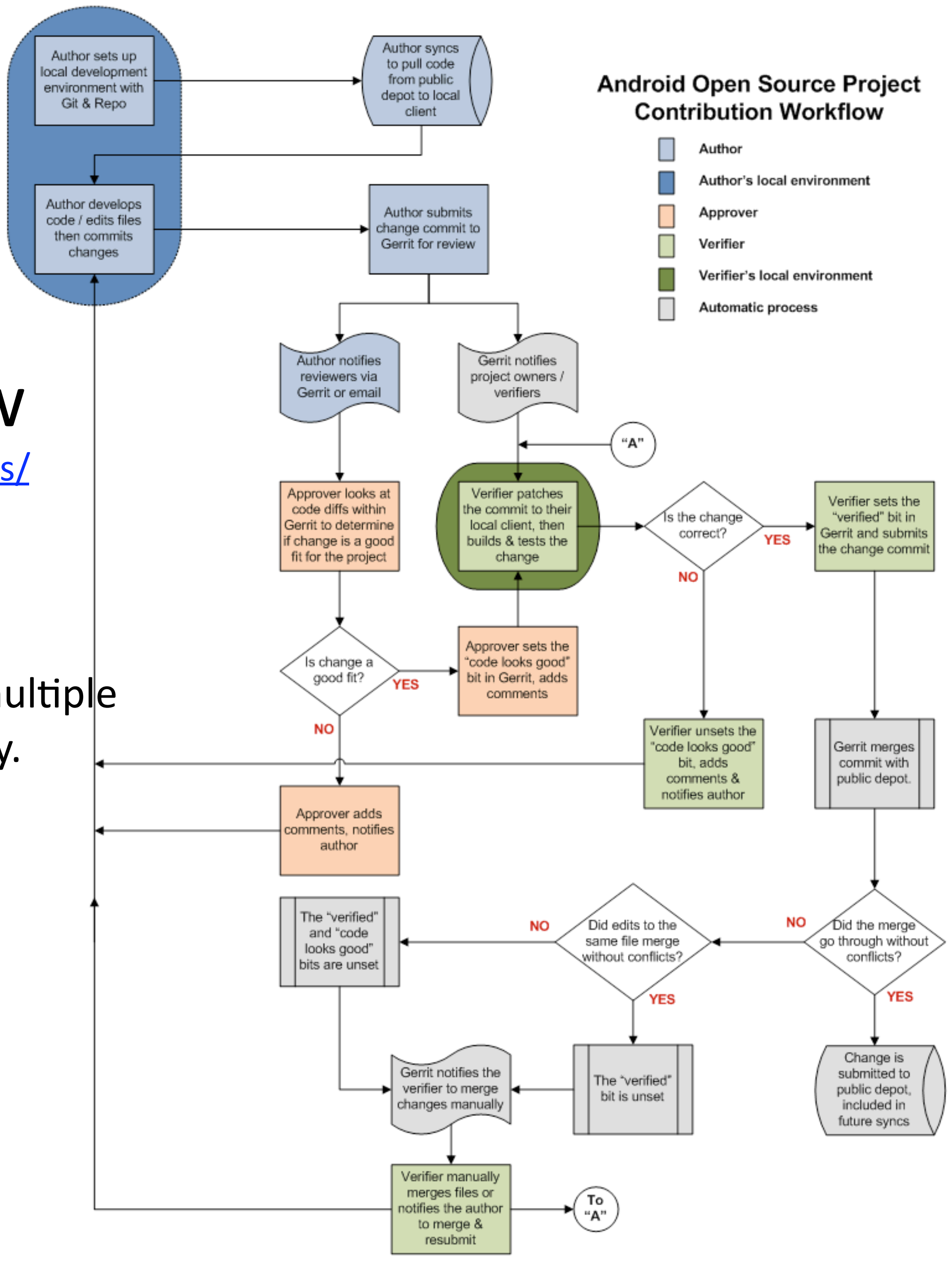


https://codebeamer.com/cb/displayDocument/workflow-c.png?object_comment_id=529&history=false&notification=false

Android Git Workflow

http://source.android.com/submit-patches/workflow

Two kinds of review, verification by multiple testers before admission to repository.



Android Open Source Project Contribution Workflow
Author
Author's local environment
Approver
Verifier
Verifier's local environment
Automatic process
Author sets up local development environment with Git & Repo
Author syncs to pull code from public depot to local client
Author develops code / edits files then commits changes
Author submits change commit to Gerrit for review
Author notifies reviewers via Gerrit or email
Gerrit notifies project owners / verifiers
"A"
Approver looks at code diffs within Gerrit to determine if change is a good fit for the project
Verifier patches the commit to their local client, then builds & tests the change
Is the change correct?
YES
NO
Verifier sets the "verified" bit in Gerrit and submits the change commit
Is change a good fit?
YES
NO
Approver sets the "code looks good" bit in Gerrit, adds comments
Verifier unsets the "code looks good" bit, adds comments & notifies author
Gerrit merges commit with public depot.
Approver adds comments, notifies author
The "verified" and "code looks good" bits are unset
NO
Did edits to the same file merge without conflicts?
YES
NO
Did the merge go through without conflicts?
YES
Gerrit notifies the verifier to merge changes manually
The "verified" bit is unset
Change is submitted to public depot, included in future syncs
Verifier manually merges files or notifies the author to merge & resubmit
To "A"

In this course

- If you use an IDE such as VB Studio or Eclipse then you can use a SCM plug-in
  - Several are available.
- However, if you are not using an IDE you will need to use command-line operations, scripts, or a separate GUI tool for version control.
- For Spring 2010 we will use Git.
  - So, you will need to learn it.
  - During your career you will probably need to learn and use several others.