Collaborative Software Development

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Software development

Several users working on a same project

- Remote or collocated users
- Each one works on their own computer (asynchronous)
  - on different tasks
  - at different times

Collaboration is hard to organize

- Versioning, synchronization between users
- Task distribution, social aspects

Outline

Collaborative software development

- Version control
- Continuous integration
- Software development methods

Outline

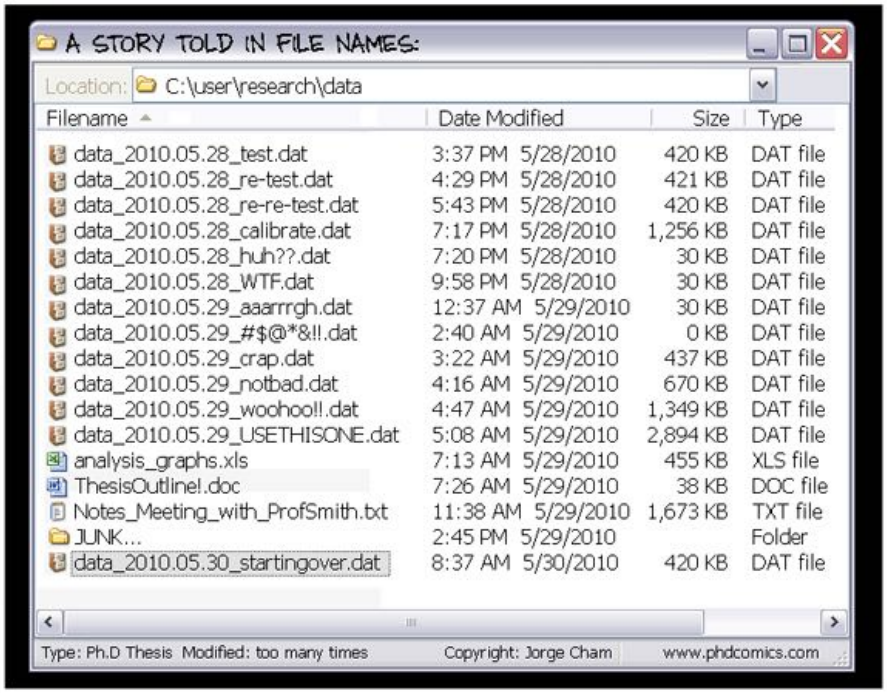
Collaborative software development

- Version control
- Continuous integration
- Software development methods

Why version control?

We want to avoid:

- Manually sharing files (USB key, email, Dropbox)
- Deleting or overwriting the files of other users
- Breaking the project by making a mistake

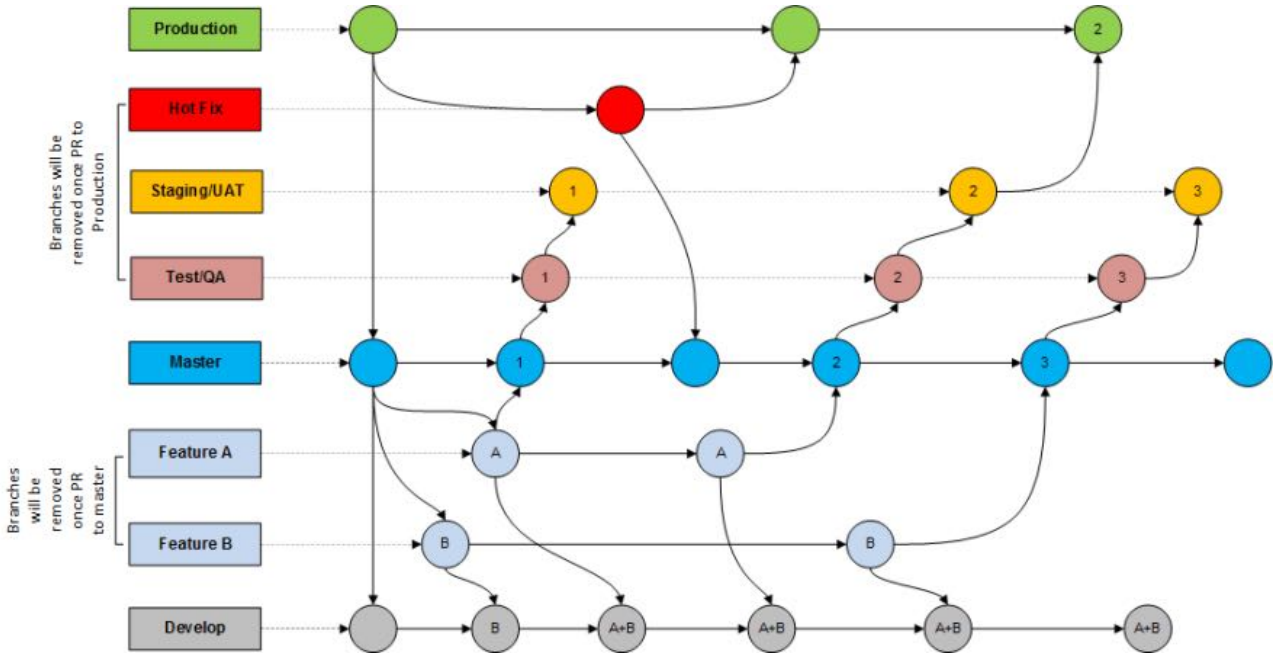


["Piled Higher and Deeper" by Jorge Cham: www.phdcomics.com]

Why version control?

We want to be able to:

- Edit the project at the same time, and merge our work
- Keep an history of the modifications, restore old ones
- Keep older versions of the files



GitFlow and GitFlowChart

Version control software



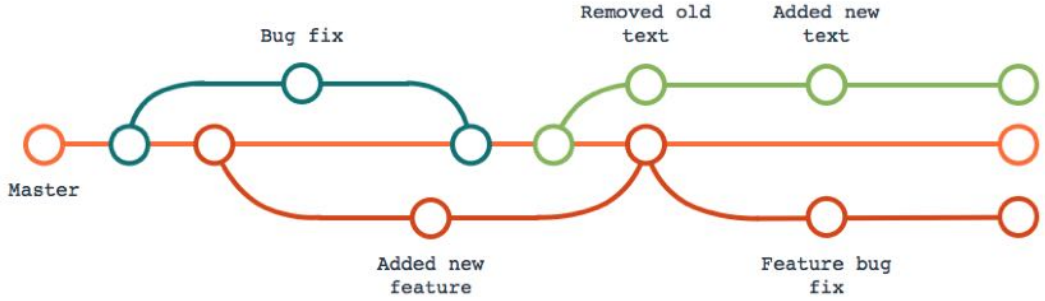



Save & restore different *versions* of the files

Synchronize users' versions

Keep track of modifications and their authors

Manage *branching* and *merging*



Not only for software development

Report, images, data from experiments

Basic version control actions

Create a repository

Create a local working copy

Add a file to the repository

Commit a change to the repository = create a new version

Update the local copy with the current state of the repository

Revert a file to a previous version

Show the history of a file

Show the differences between two versions

Version control software architectures

Centralized

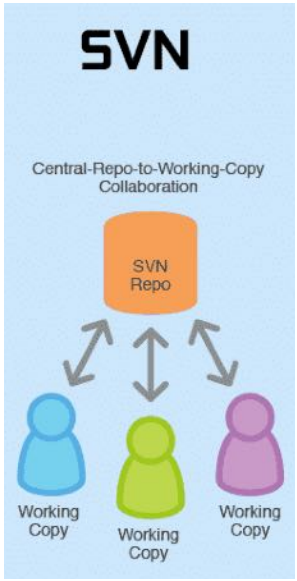
CVS, **SVN**, TFVC, …

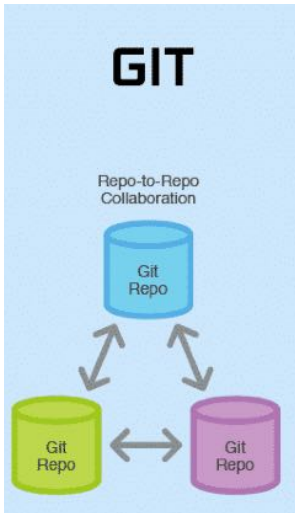
Decentralized (peer-to-peer):

GNU Arch, Mercurial, Bazaar, **Git**,…

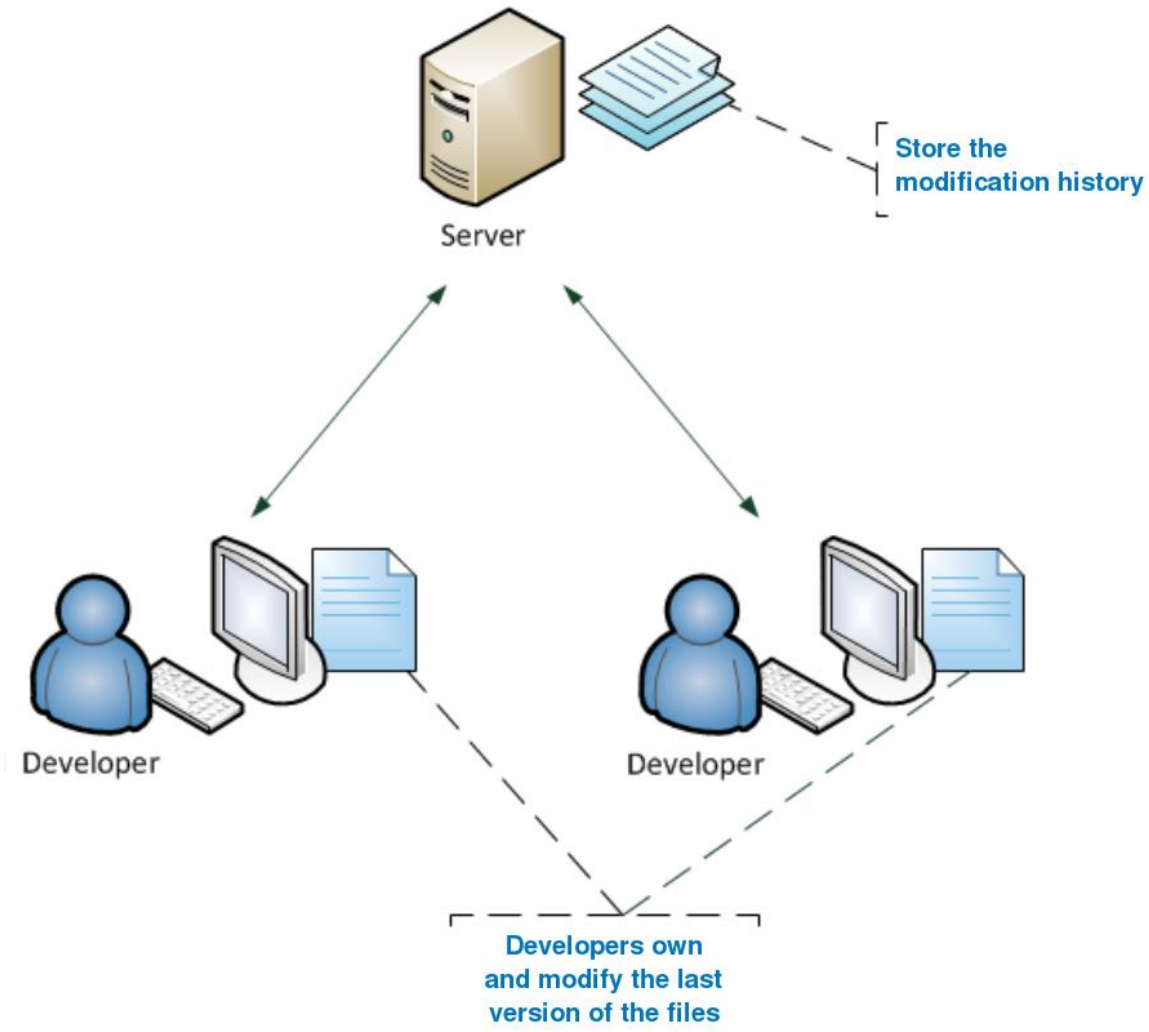
Decentralized can be used as a Hybrid Architecture

One peer can be a central server (github)





Centralized architecture



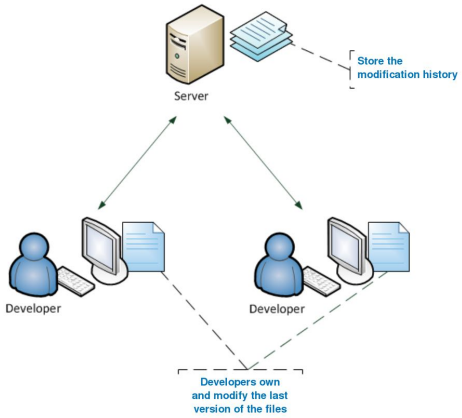
Drawbacks of centralized architecture

Single access point to the data

Single communication point between users

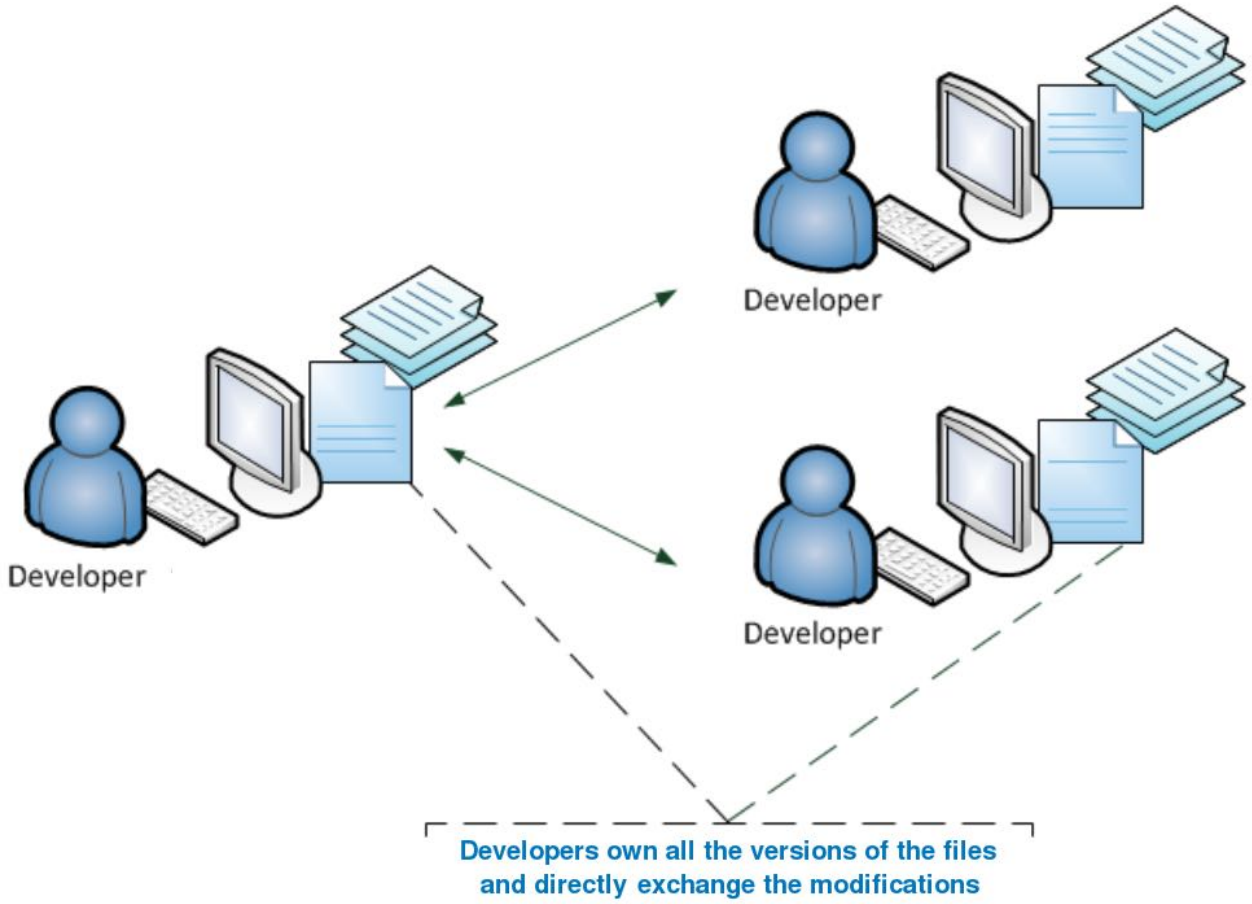
Single history / timeline of the files

Versioning and sharing are the same operation

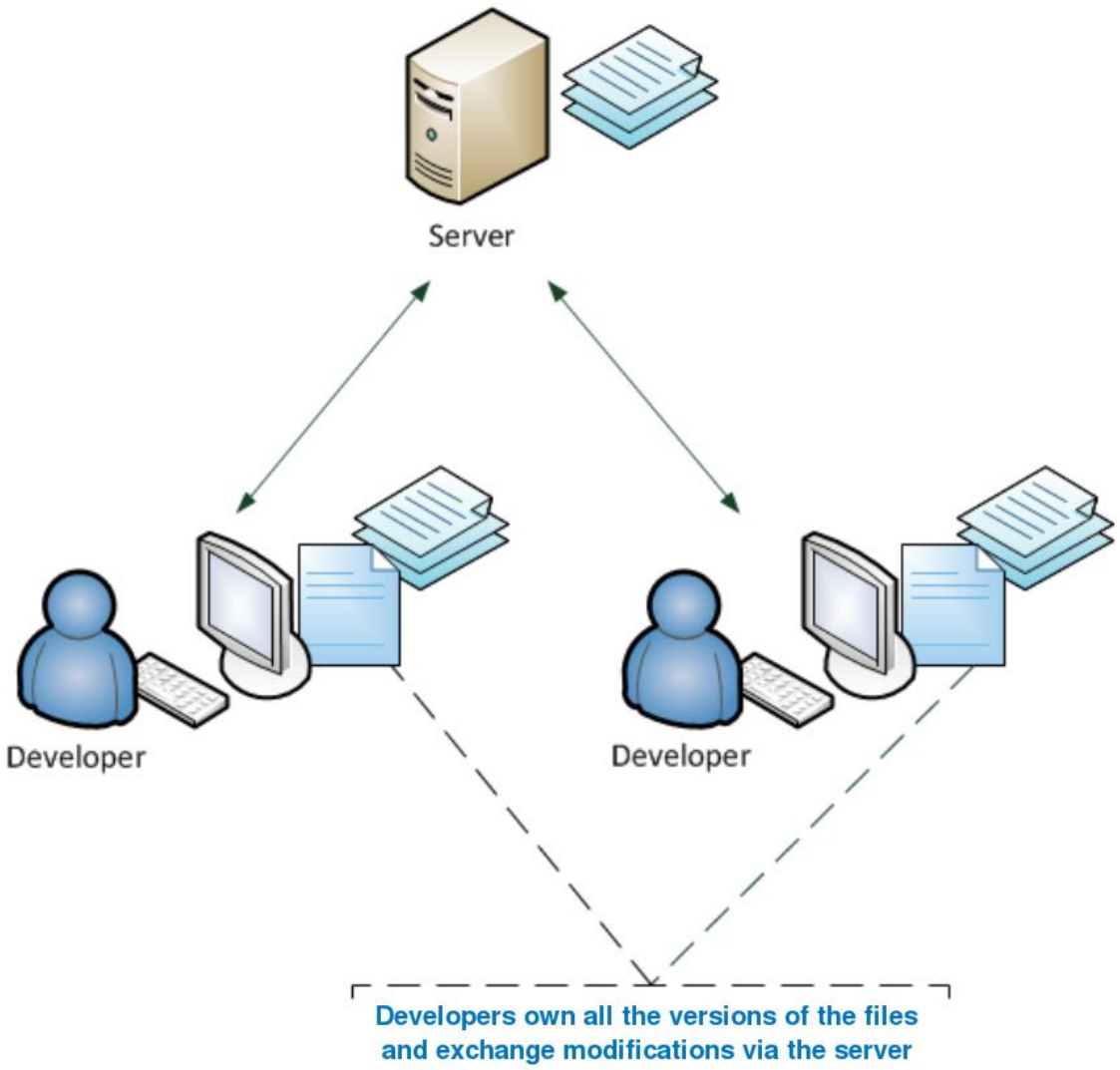


Need to have a stable state before “committing" a change

Decentralized architecture



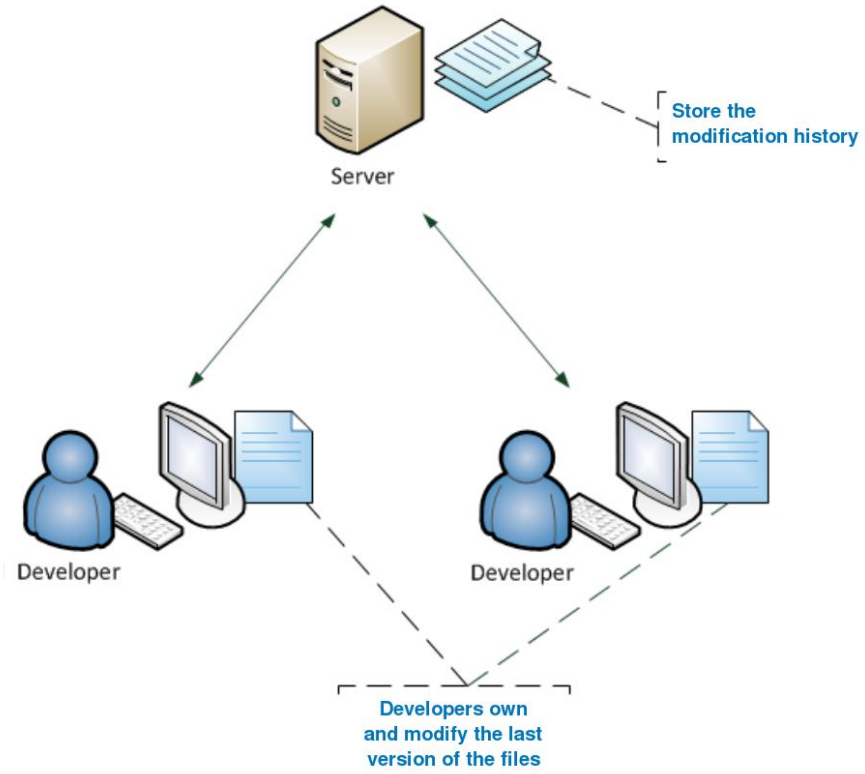
Hybrid architecture



Vocabulary (SVN)

- Architecture
  - Repository
  - Working copy
- Actions
  - Checkout
  - Add
  - Commit
  - Update
  - Revert
  - Diff, log, status

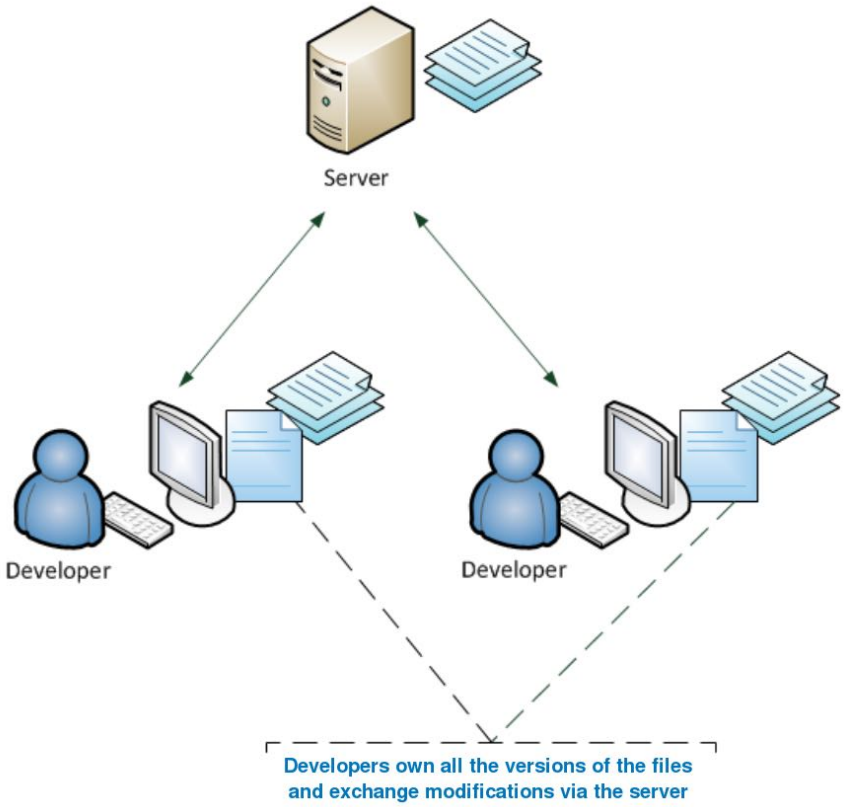
Centralized Architecture



Vocabulary (git)

- Architecture
  - Remote and local repository
  - Working copy
- Actions
  - Clone
  - Add
  - Commit
  - Push / Pull
  - Reset
  - Diff, log, status

Hybrid Architecture



Good practices

- Work on the local copy
- Before sending a modification
  - Check if the code compiles locally
  - Check for updates from the other users
    - Manage conflicts if there are some
  - Check if the code compiles with the updates
- Commit the change to the repository

Conflict management

Multiple users can make changes to the same (text) file

- If the changes do not overlap
  - => the system merges the changes
- If the changes do overlap
  - A conflict appears, to be resolved “by hand”
    - By telling to the system which version is correct
    - By merging the modifications of the users

Conflict management

```
C:\workspace\test>svn update
Conflict discovered in 'test.txt'.
Select: (p) postpone, (df) diff-full, (e) edit, (r) resolved,
        (mc) mine-conflict, (tc) theirs-conflict,
        (s) show all options: p
C    test.txt
Updated to revision 3.
Summary of conflicts:
  Text conflicts: 1
```

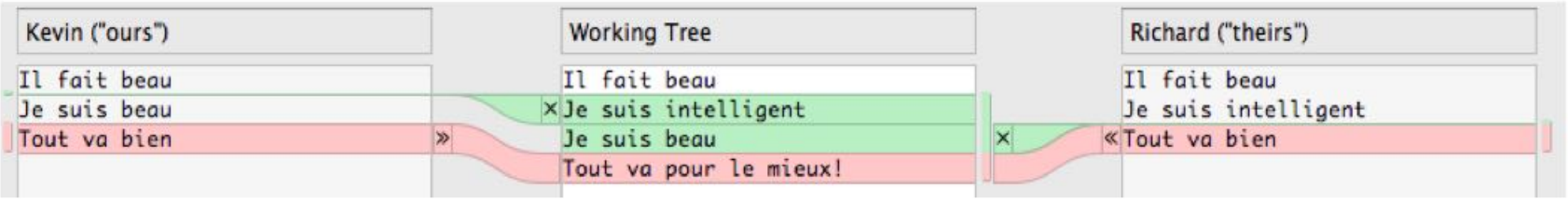
```
08/10/2010  11:44 AM                94 test.txt
08/10/2010  11:44 AM                26 test.txt.mine
08/10/2010  11:44 AM                27 test.txt.r2
08/10/2010  11:44 AM                31 test.txt.r3
```

test.txt

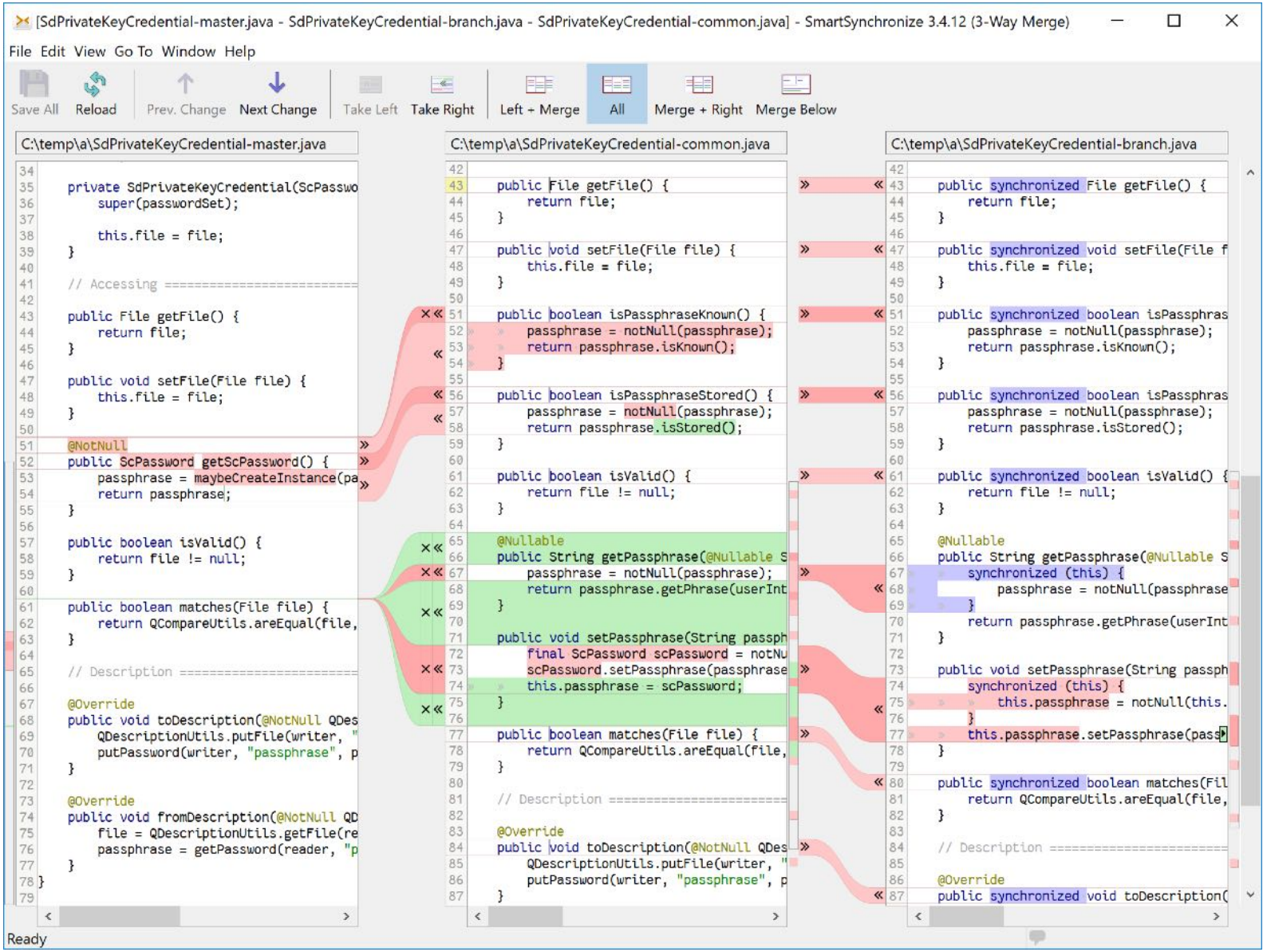
```
<<<<<<< .mine
test User2 making conflict
=======
User1 am making a conflict test
>>>>>>> .r3
```

Version control

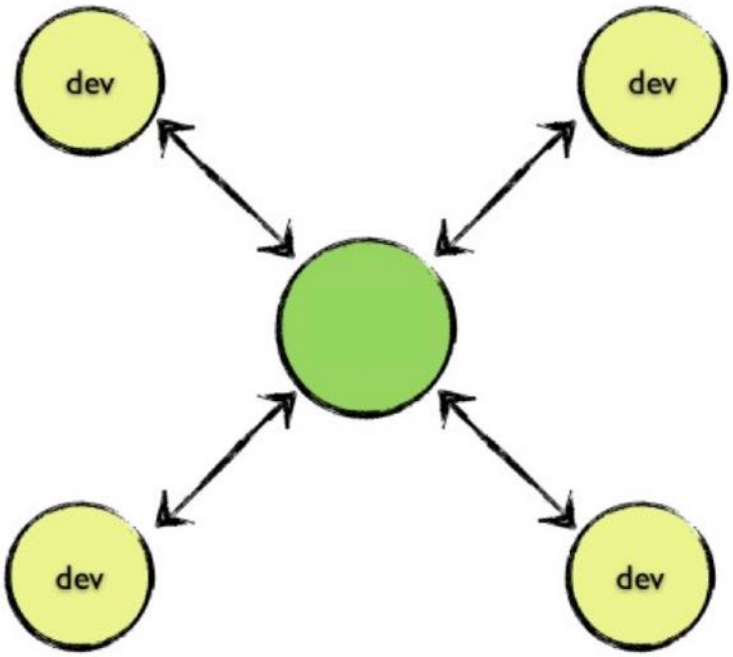
Tools for conflict management (SmartGit)



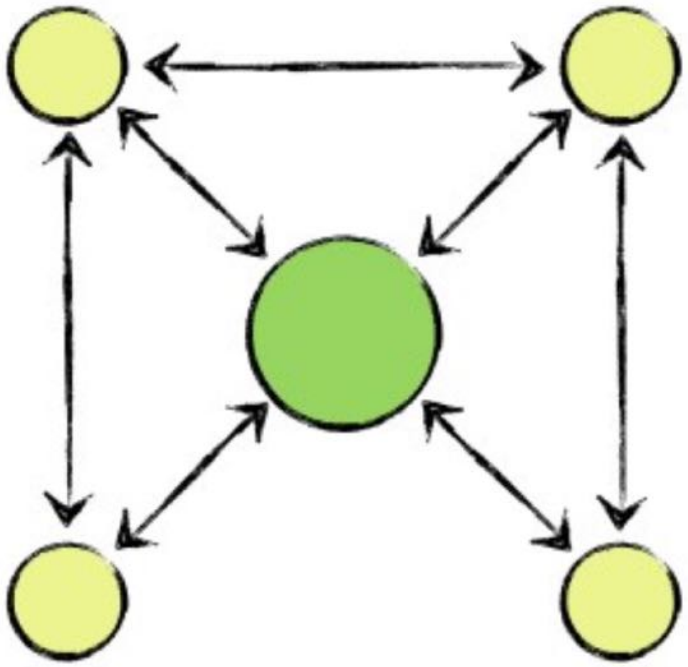
Three-way merge



Collaboration scenario: centralized (SVN)



Collaboration scenario: decentralized (Git)

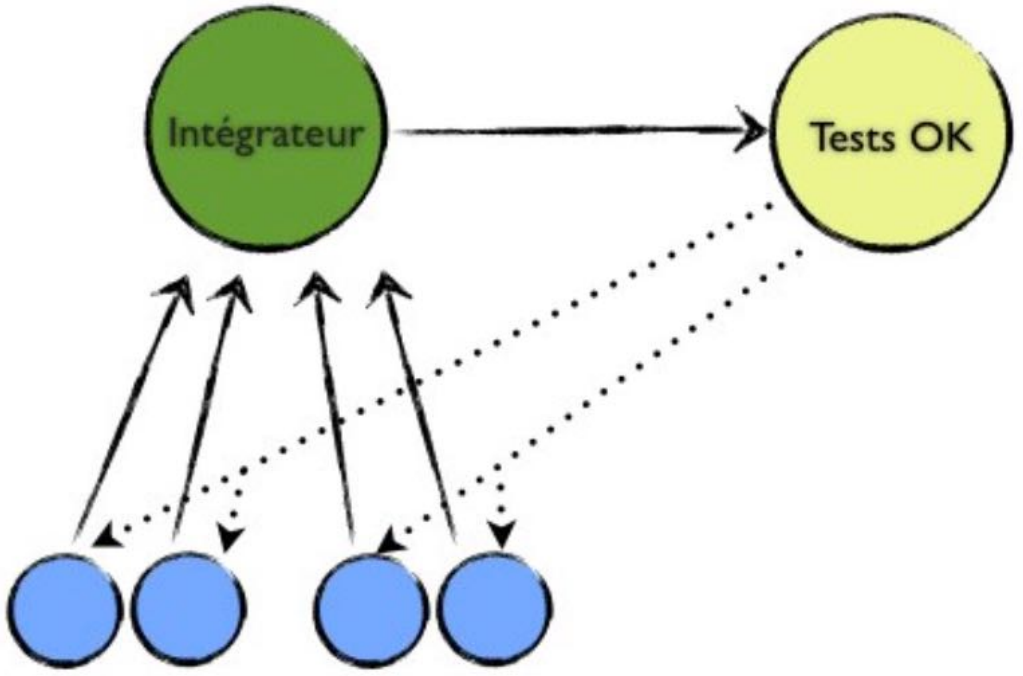


Inter-personal communications

Collaboration scenario: decentralized (Git)

Integration mode

A repository is in charge of the test

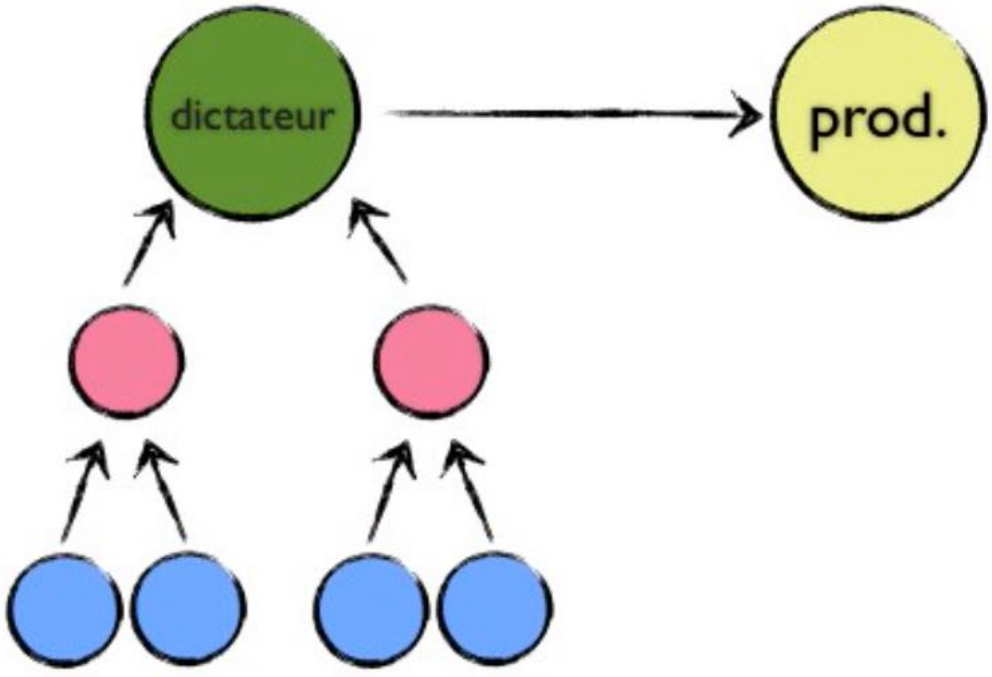


Collaboration scenario: decentralized (Git)

Dictator mode

Open-source projects

"Lieutenants" make a first check
before sending to the "dictator"

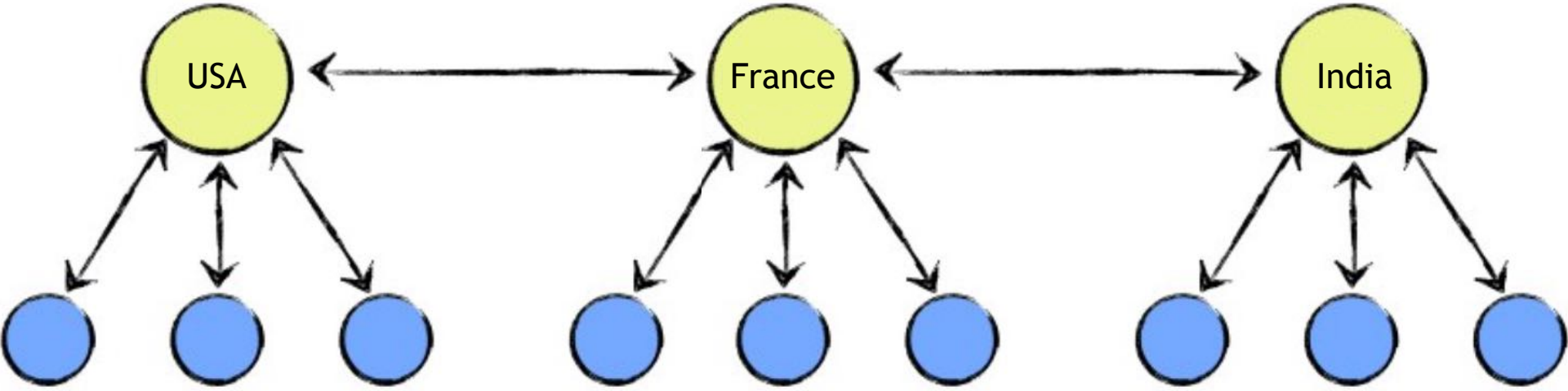


Collaboration scenario: decentralized (Git)

Multi-location teams

Each team can work independently

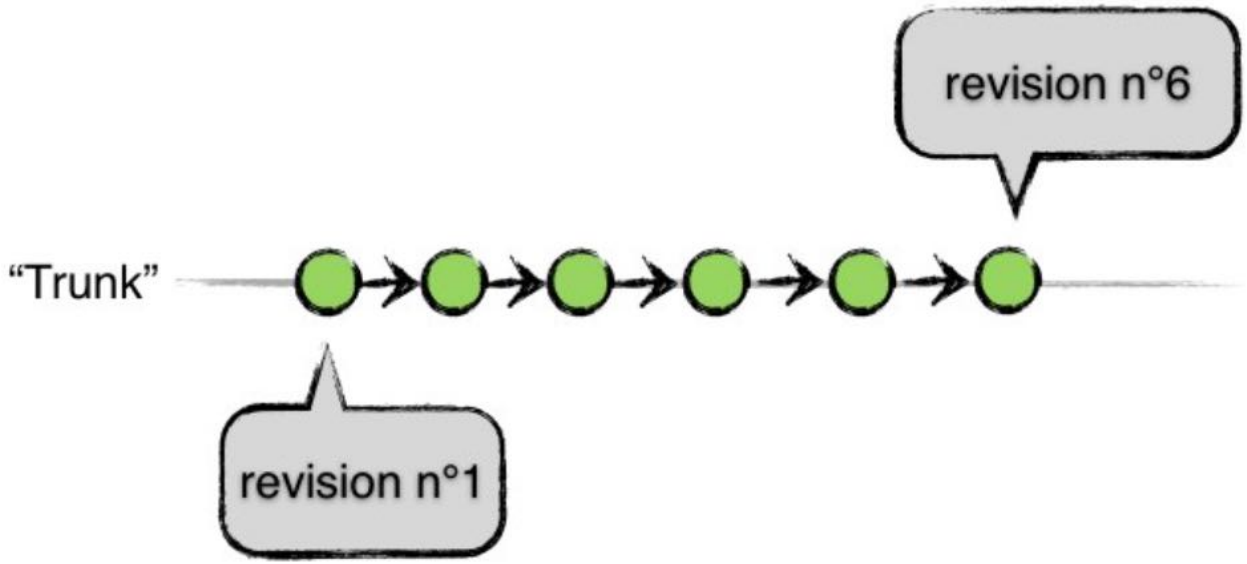
Regular integration of the work of each team



History management

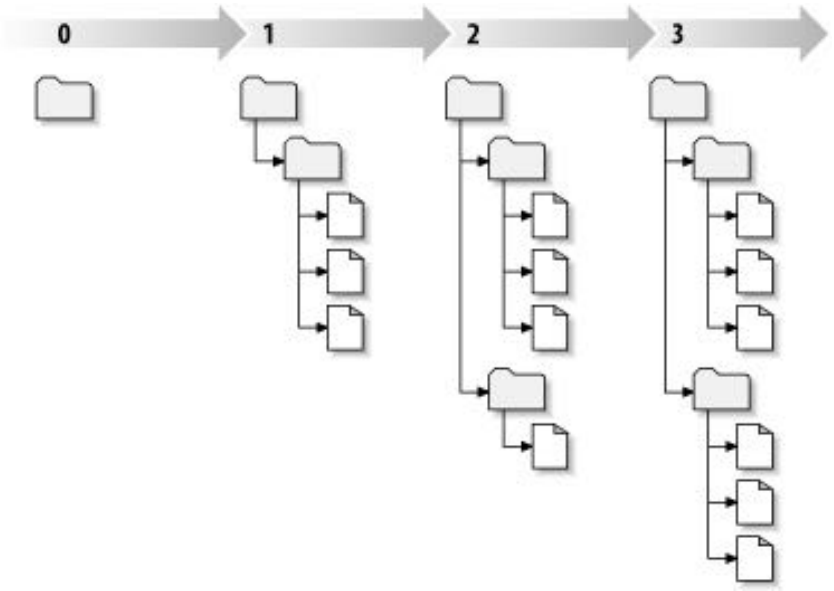
The repository stores differences between text files

Computation of the history is linear
when considering the order of “commits”



History management

SVN assigns a revision number to the entire project

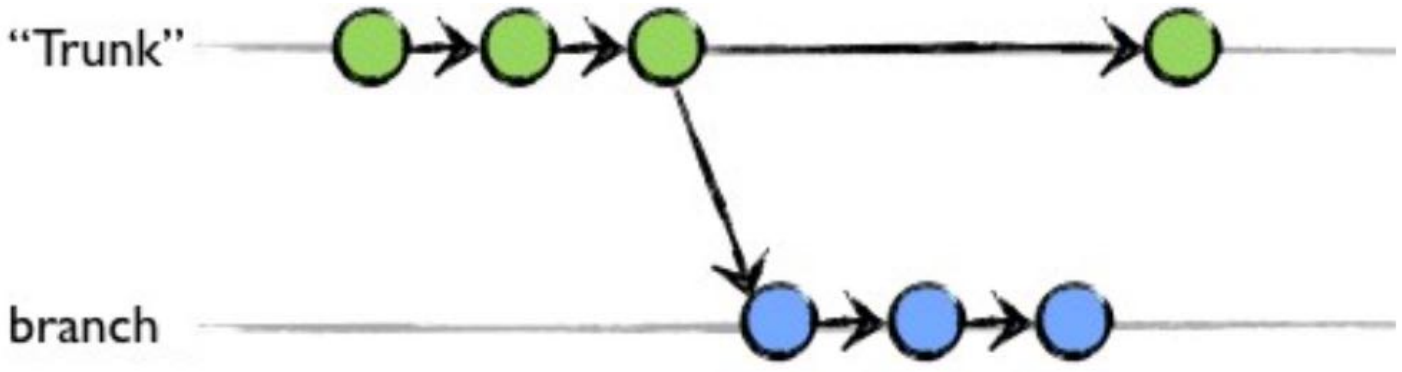


Git assigns a revision number per file

This difference impacts collaboration

Using branch for collaboration is easier with Git

Branch management

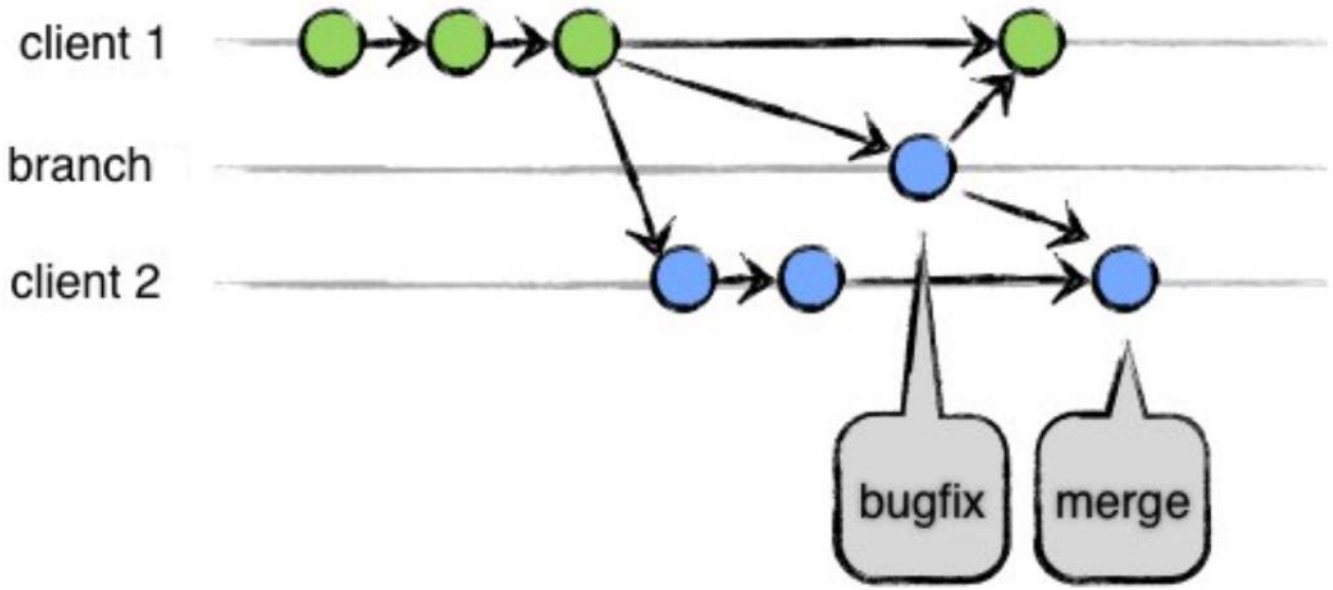


SVN makes a copy of the entire repository

Git makes a link to a particular state of the files

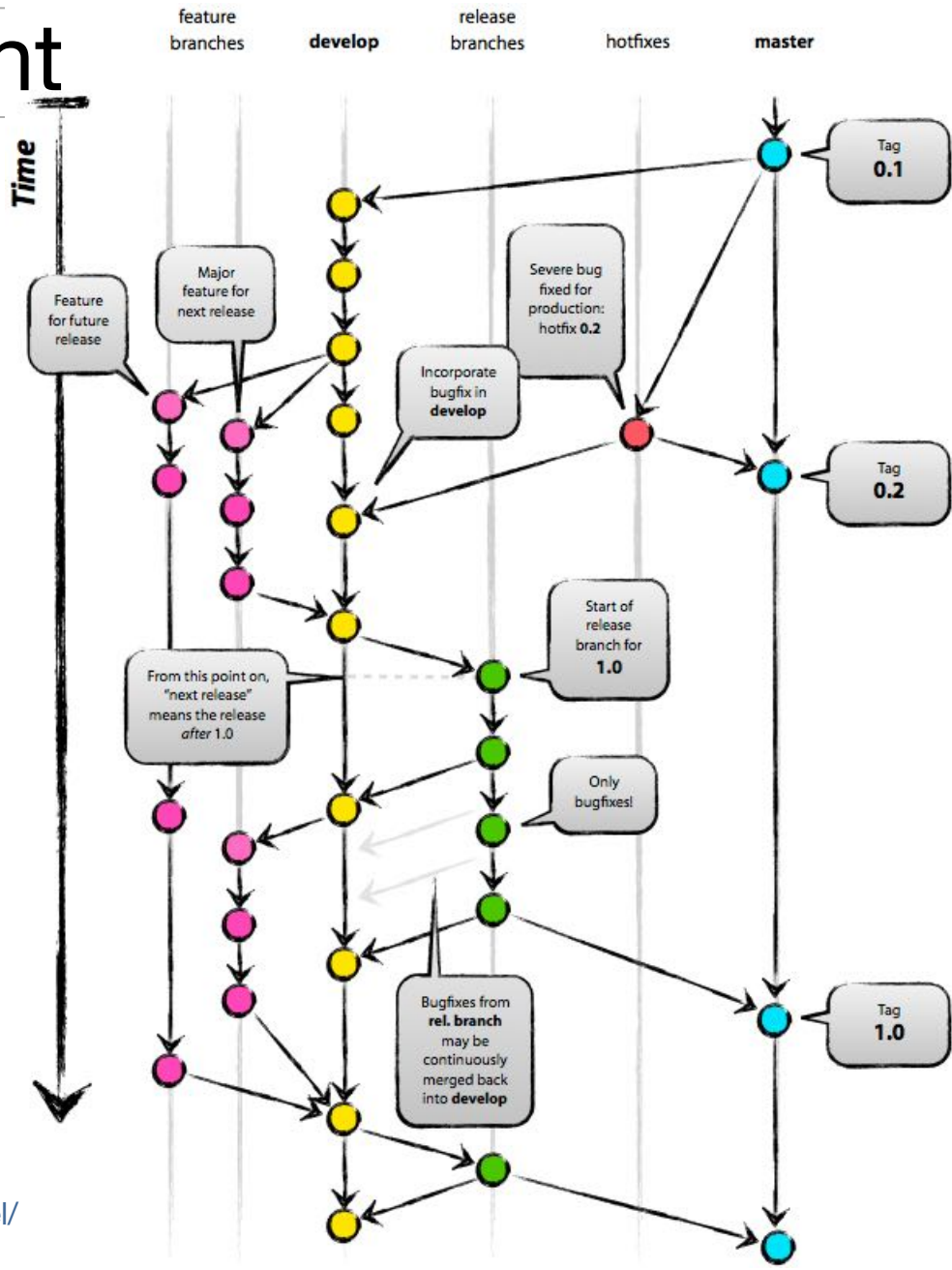
Branch management

Merging branch (very complex to achieve with SVN)



Branch management

Classical organisation of a project into branches

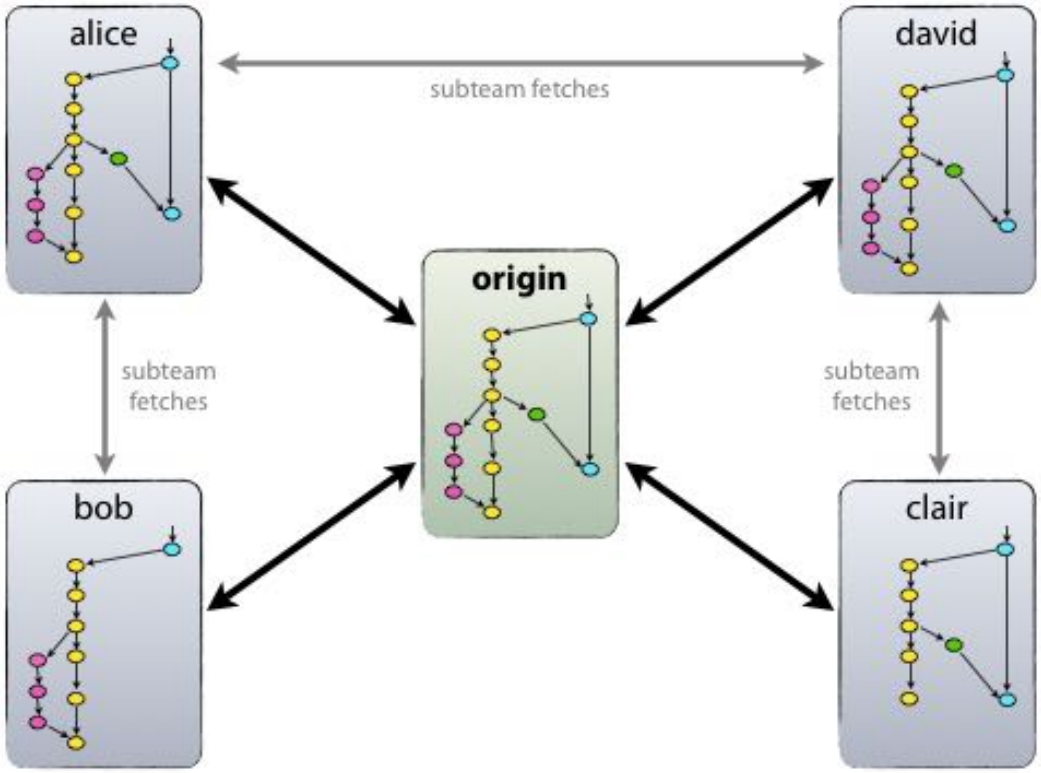


http://nvie.com/posts/a-successful-git-branching-model/

Branch management

Each user can work on a particular branch (or branches)

Branches can be synchronized between users



Web-based interfaces

Manage user access rights

Manage branches and access to branches

Review modifications and different versions

Track bugs

Create wiki / web pages for projects

Add social network functionalities

Outline

Collaborative software development

- Version control
- Continuous integration
- Software development methods

Continuous integration

Integration

- Continuous merging & testing the work of several developers
- Automatic deployment
- System always running

Goals

- Test modifications from the beginning
- Detect integration problems at an early stage
- Always have the system running
  - Tests, demos, discussion with the customers

http://martinfowler.com/articles/continuousIntegration.html

Principles of continuous integration

Version control in a repository

Automatic and fast build

Auto-testing

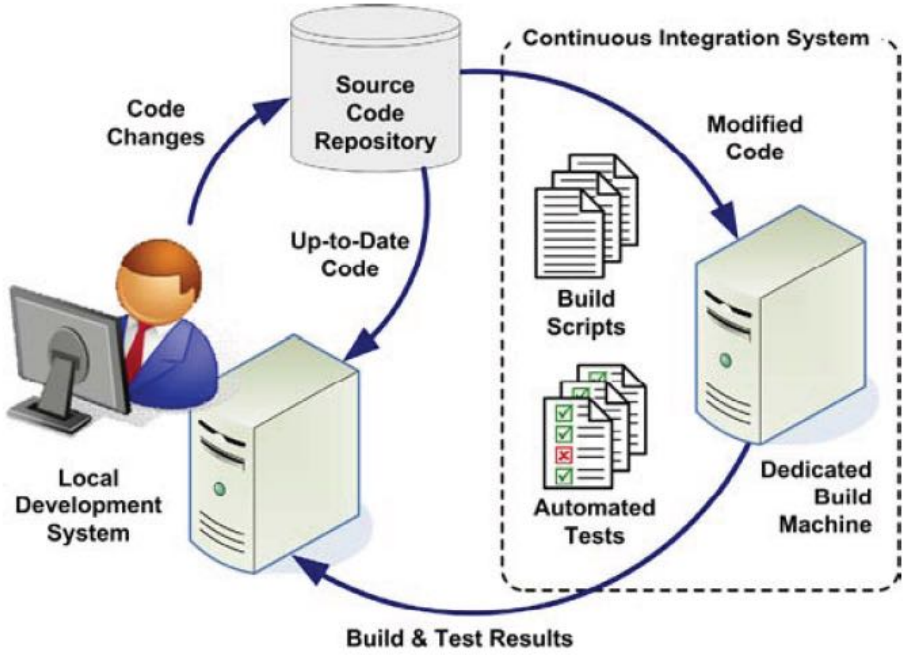
"Commit" every day

Deployment on an integration computer after each "commit"

Automatic deployment

Executable always available

Everybody knows the build state



Feedback for collaboration (awareness)

Token on the desk of the person who builds

Make a sound when a build is valid

Web page of the integration server

Bubble light

Wallboard

Outline

Collaborative software development

Version control

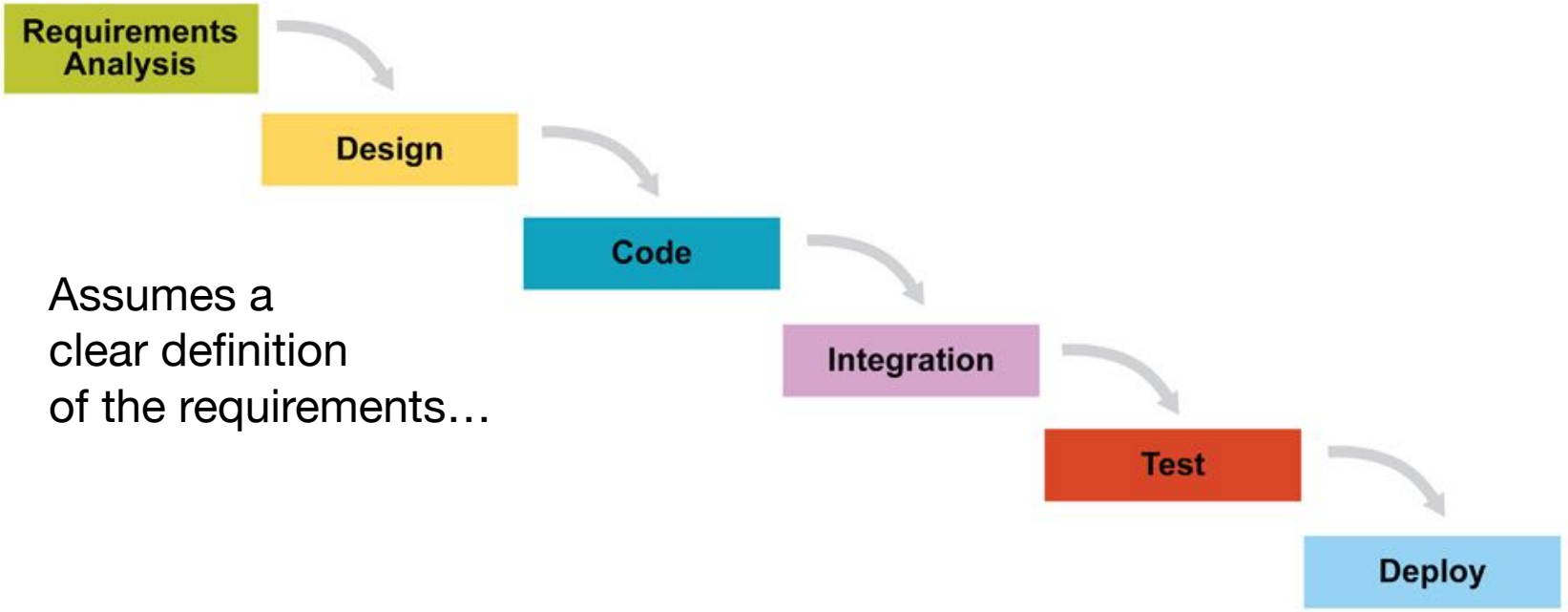
Continuous integration

Software development methods

Methods for software development

- No methods: “Code and fix”
  - Efficient for small projects
  - Difficult to add new features or to find bugs
- Engineering / plan-driven methodologies
  - Comes from civil or mechanical engineering
  - Drawing / construction plan / task distribution / construction
- Agile methodologies
  - Adaptive rather than predictive
  - People-oriented rather than process-oriented

Classic methodology: the waterfall



Assumes a
clear definition
of the requirements…

… and a clear ending

Predictability

Is software development end-result predictable?

Yes in some cases…

NASA programs (maybe)

Usually, requirements are unpredictable
(especially for software involving interaction with users)

Users / customers don't precisely know what they want

Hard to evaluate the cost of different options

Hard to estimate which features are useful

⇒ Requirements should be flexible

Agile manifesto

Manifesto for Agile Software Development

Individuals and interactions over processes and tools

Working software over comprehensive documentation

Customer collaboration over contract negotiation

Responding to change over following plan

http://agilemanifesto.org

Agile methods

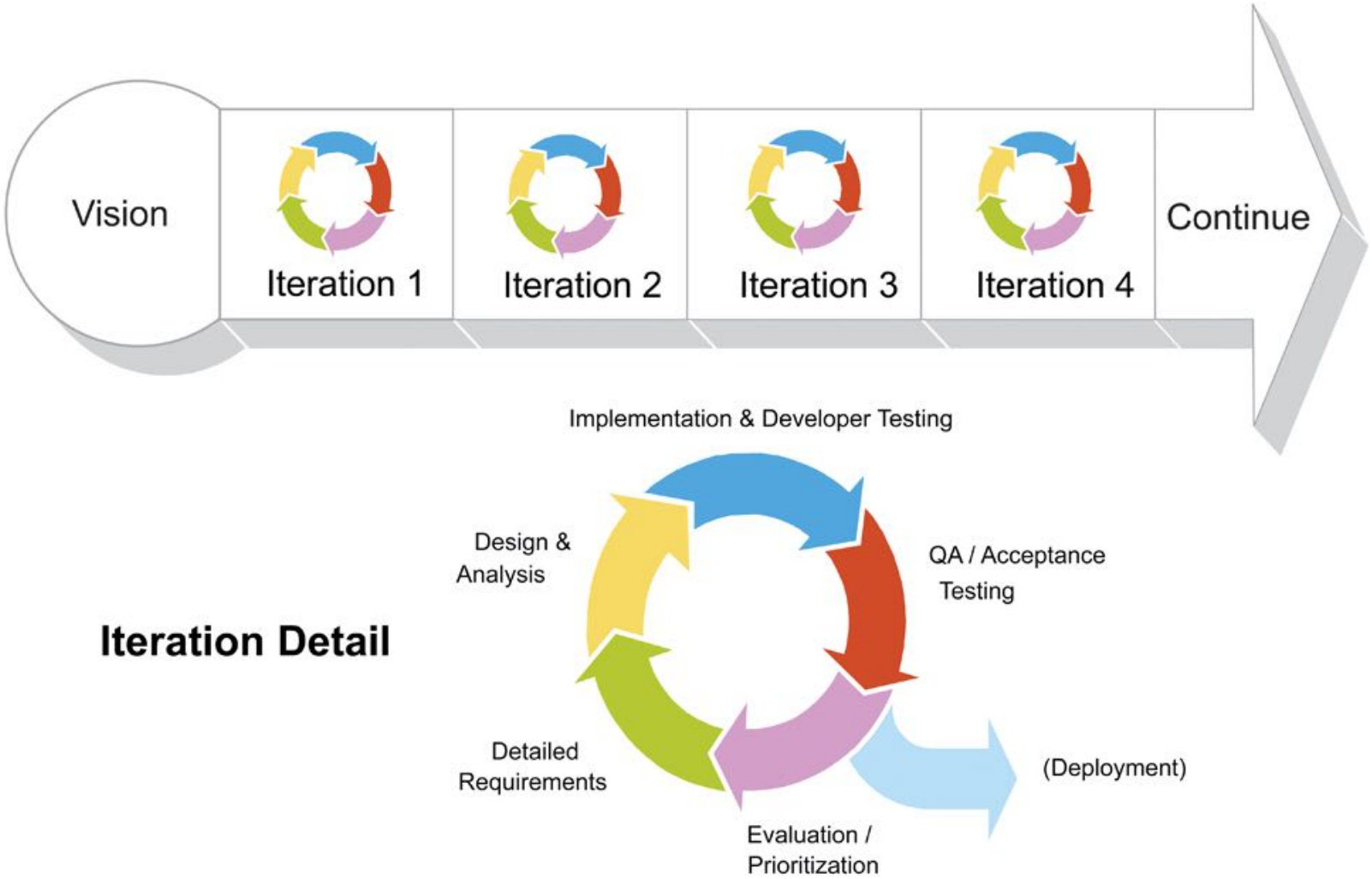
Deal with unpredictable requirements

- Iterative development
  - Involve the customers at each iteration
  - Improve the team organization (self-adaptive process)

- Effective team of developers (people first)
  - Do not consider developers as replaceable parts
    - Analysts, coders, testers, managers
  - Developers are professionals who
    - make the technical decisions
    - evaluate the time required to perform the tasks

http://agilemanifesto.org

Agile methods



Agile methods

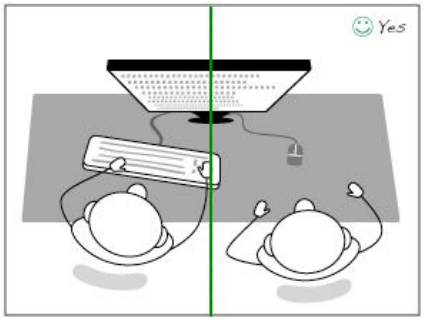
Examples

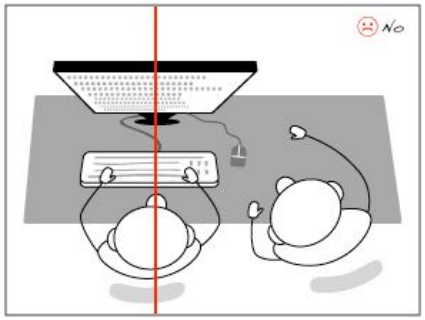
- XP (Extreme Programming)
  - Test driven development, pair programming
- Scrum
- Crystal
  - Safety, efficiency, habitability (less disciplined than XP)
- Open source process
  - Distributed contributors, parallelized debugging
- Lean software development (Lean development @ Toyota)
  - Just in time, Jidoka ("automation with a human touch")
- RUP (Rational Unified Process)
  - Use case driven, iterative, architecture centric

Pair/peer programming

Two programmers

One computer





Roles

Driver: operates mouse and keyboard

Code: syntax, semantics, algorithm

Navigator: watches, learns, asks, talks, makes suggestions

Higher level of abstraction

Test, technical task, time since the last commit,

Quality of the overall design

Pair/peer programming

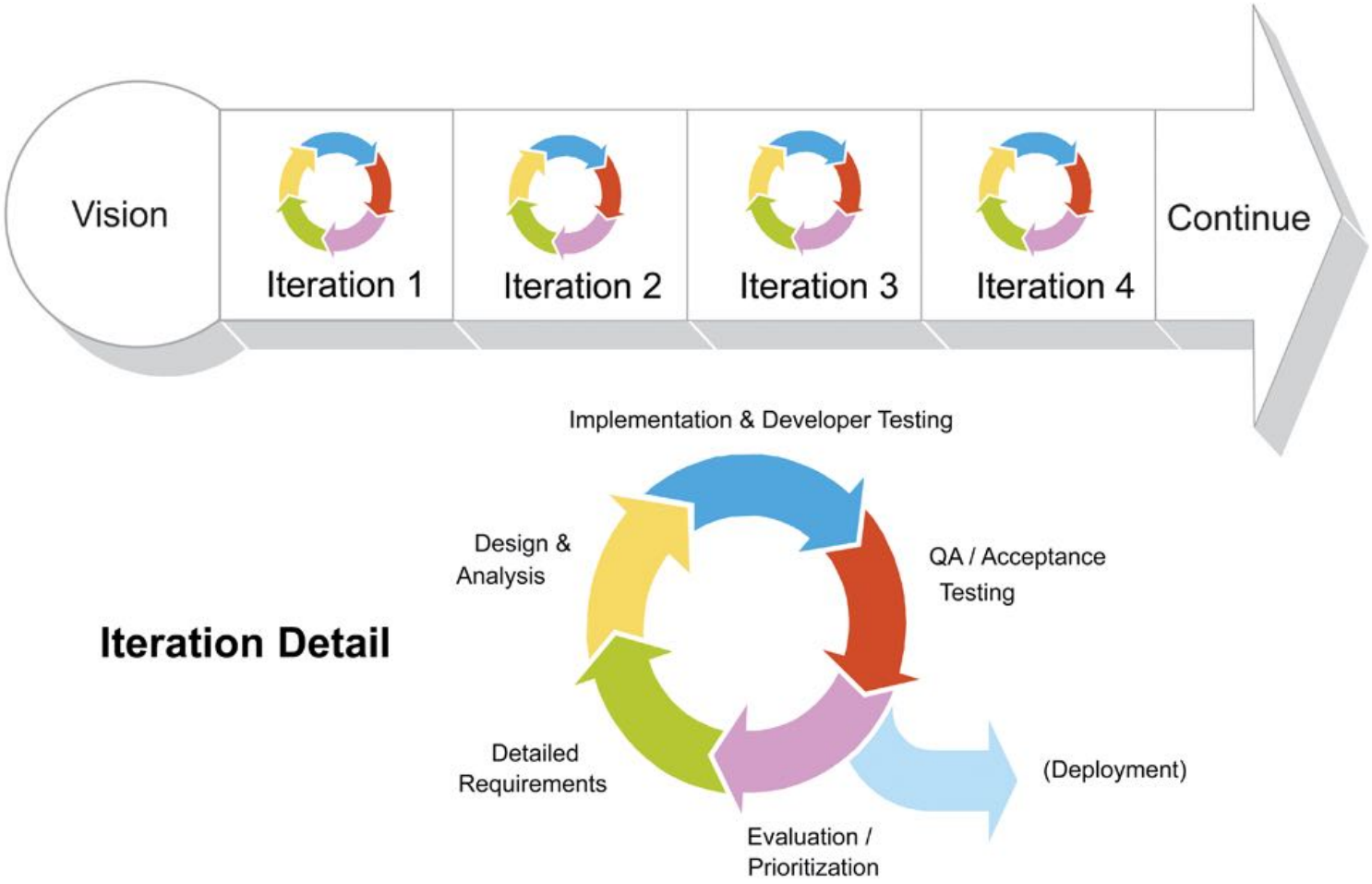
- Advantages
  - Code quality
    - Better designs, Fewer bugs
  - Productivity
    - May be lower in short term, but higher in long term
  - Spreading Knowledge
    - Pairs have to switch regularly
    - Technical and conceptual knowledge
  - Social aspects
    - No loneliness, conviviality, better motivation

Pair/peer programming

- Pairing strategies
  - In XP, all production code is written by pairs
  - In non-XP agile teams, usually pairing is not used at all
    - A trade-off can be found for some tasks
      - Mentoring new hires
      - Extremely high-risk tasks
      - Start of a new project when the design is new
      - When adopting a new technology
    - On a rotating monthly or weekly basis
    - Developers who prefer to work in pairs

Scrum

Iterations called Sprint (about 1 month)



Scrum: roles

Product Owner (one person)

- Responsible for products vision
- Constantly re-prioritizes the Product Backlog
- Accepts or rejects product increment

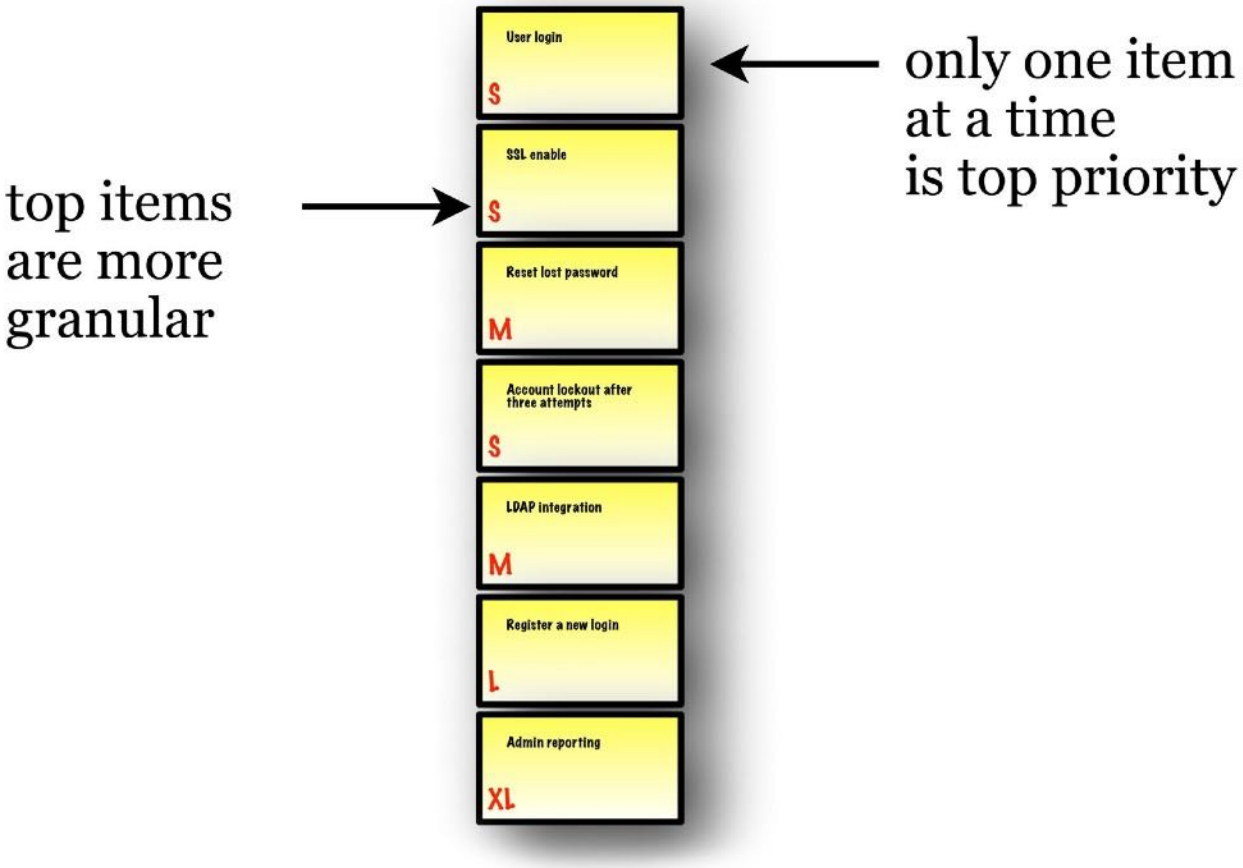
Development team

- Self-organized
- Negotiates commitments with the Product Owner
- Has autonomy regarding how to reach commitments
- Intensely collaborative

Master

- Facilitates the Scrum process
- Helps resolve issues
- Shields the team from external inferences and distractions
- Has no management authority

Scrum: product backlog

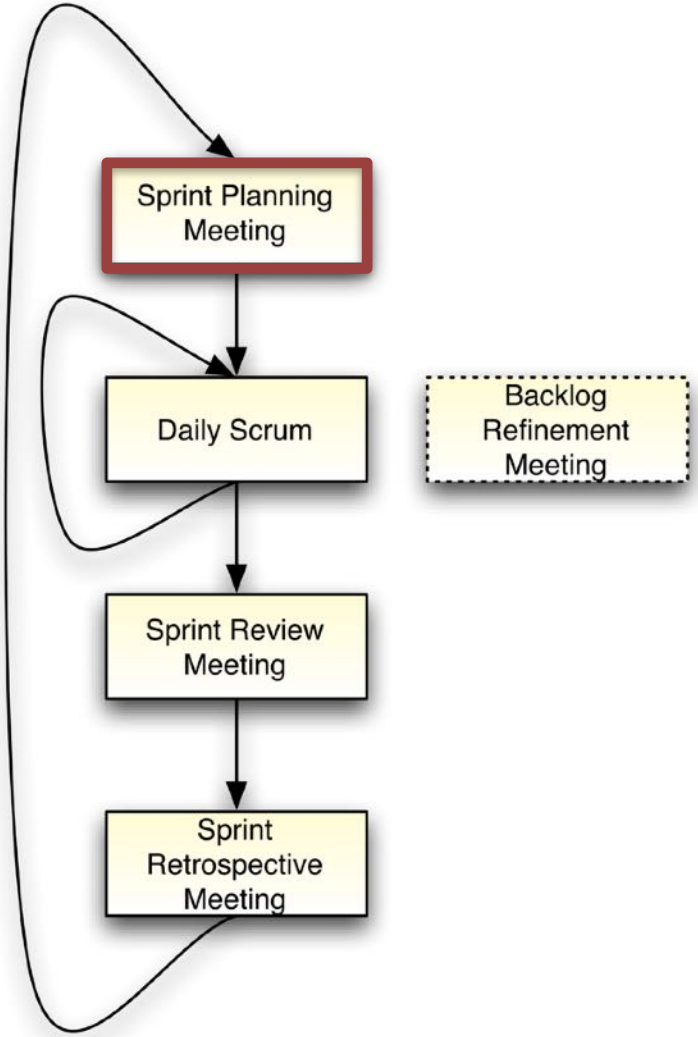


Sprint planning

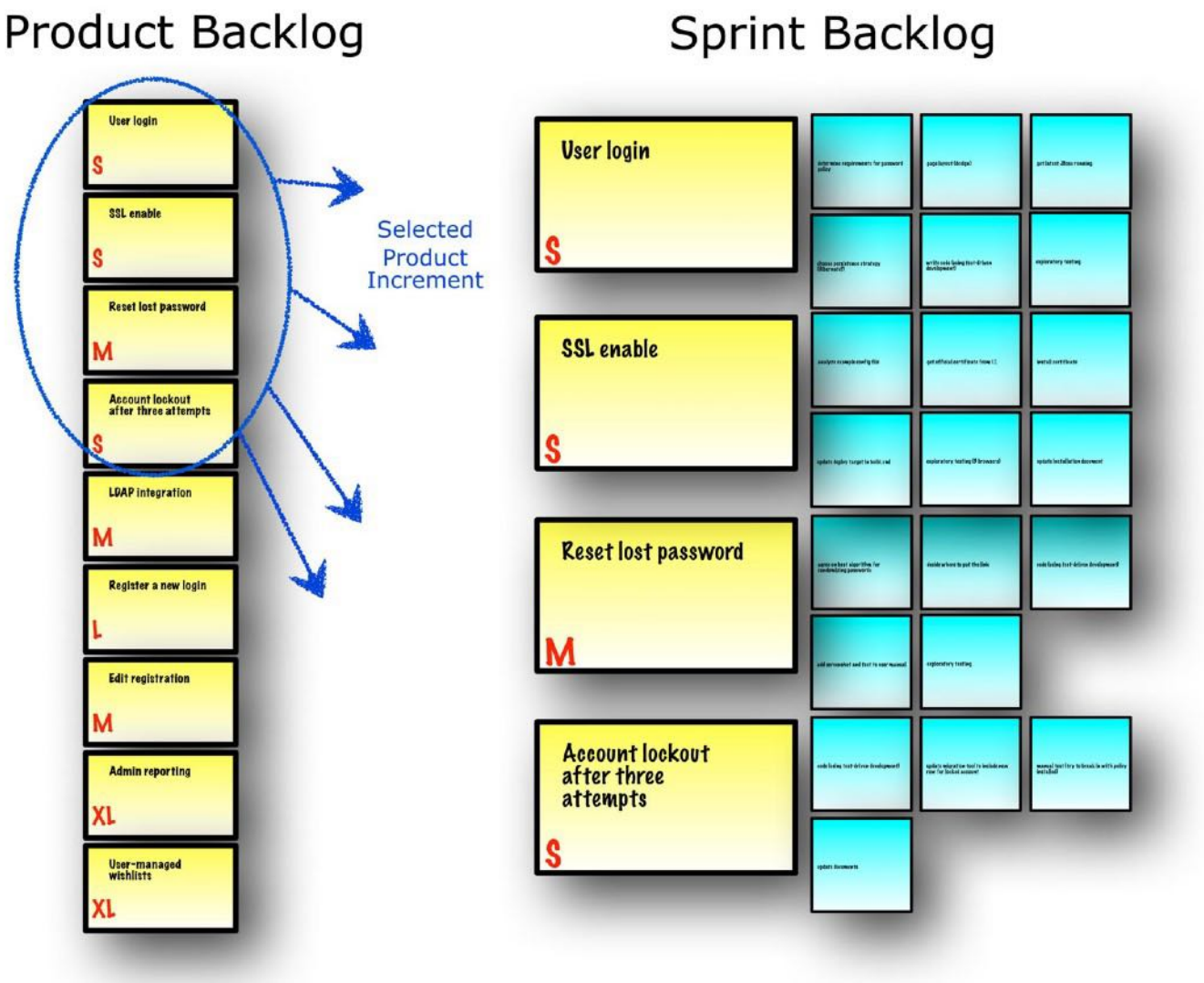
Planning Meeting

Negotiate which
Product Backlog items
will be processed

Break items into
a list of sprint tasks



Sprint backlog

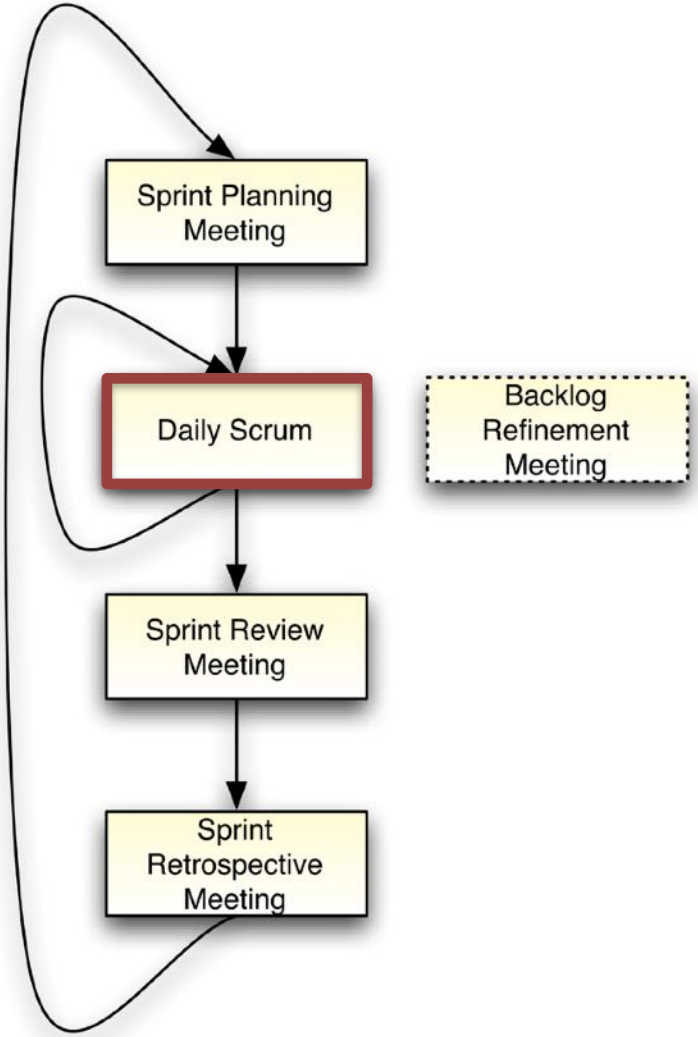


Daily scrum

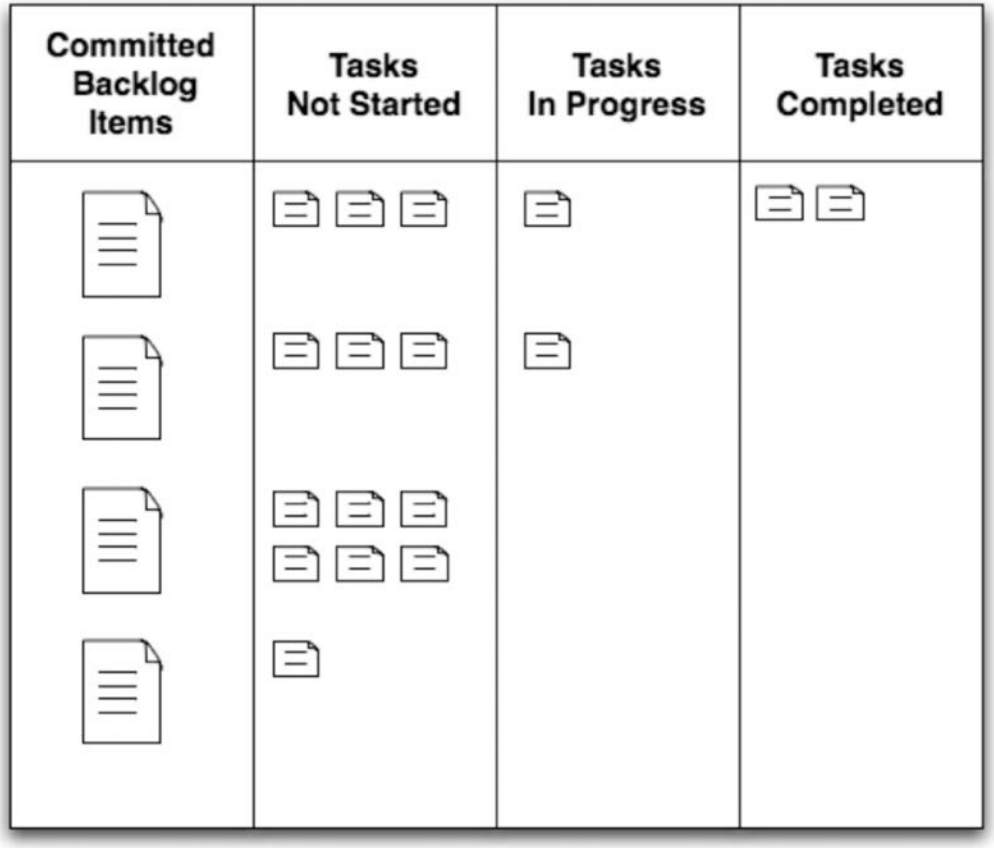
Planning Meeting

Daily Meeting

- Same time and place
- 15 minutes, standing up
- Summarize work of previous day, work of today, issues
- Maintain tasks list (not started, in progress, done), issues list and burn-down chart
- Product Owner may attend



Sprint backlog



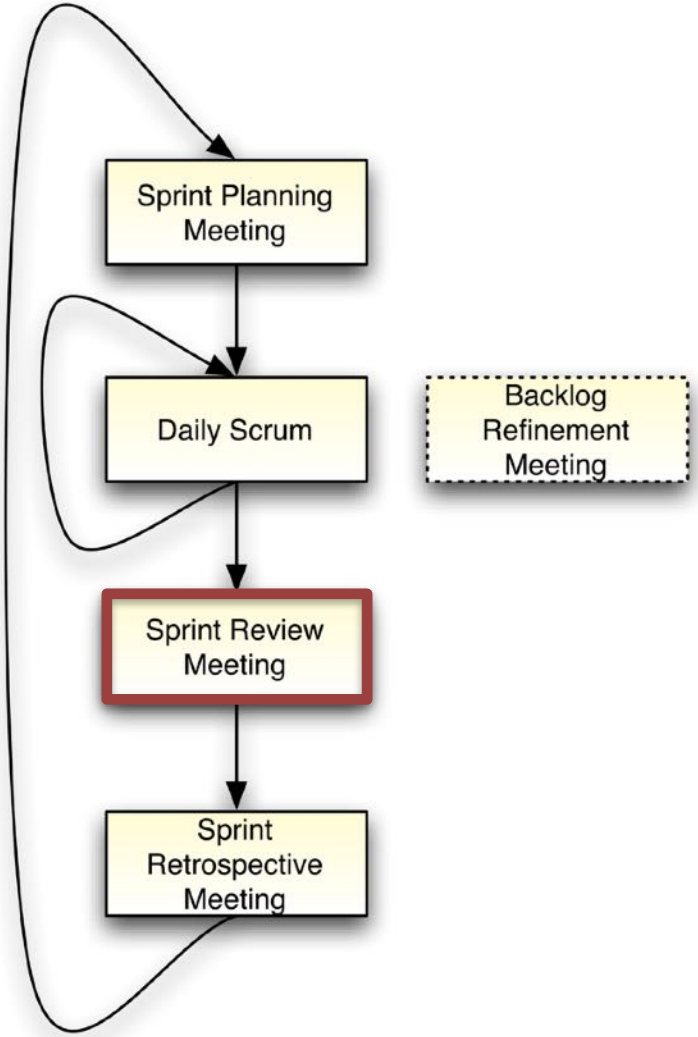
Sprint review

Planning Meeting

Daily Meeting

Review Meeting

- Demonstrate the working product increment to the Product Owner
- Product Owner declares which items are done
- Unfinished items return to the Product Backlog
- Master proposes new items for the Product Backlog



Sprint retrospective

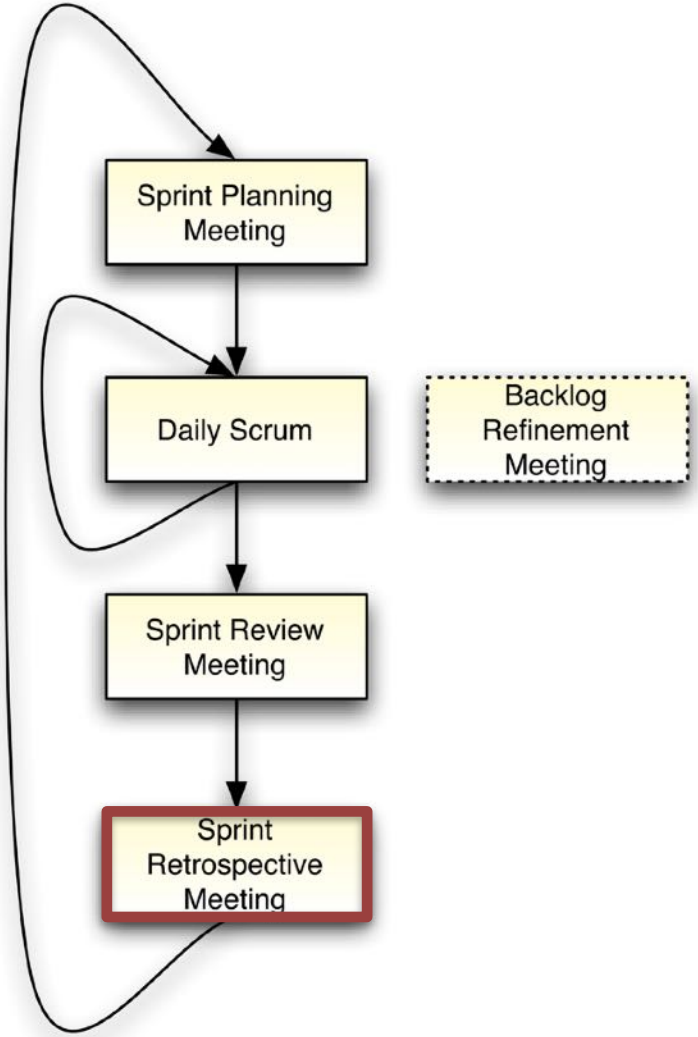
Planning Meeting

Daily Meeting

Review Meeting

Retrospective Meeting

- Team reviews its own process
- Team adapts it for future Sprints
- Master has to manage the psychological aspects of the meetings



Backlog refinement

Planning Meeting

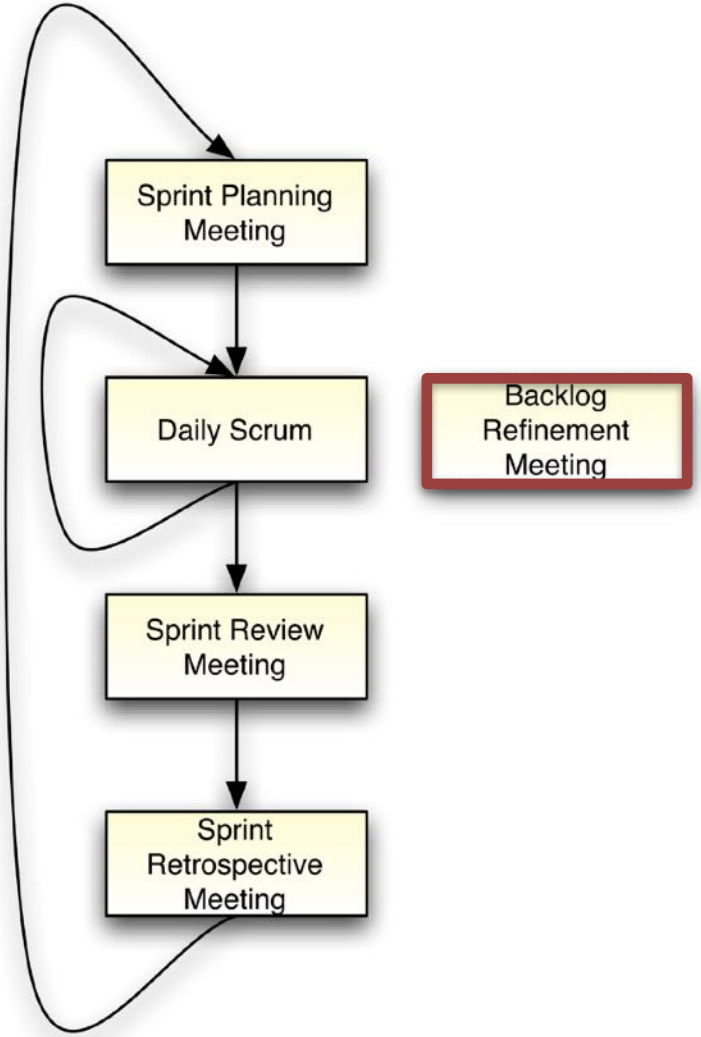
Daily Meeting

Review Meeting

Retrospective Meeting

Backlog Refinement Meeting

- Items are usually too large or poorly understood
- Refine items into smaller ones
- Master can help

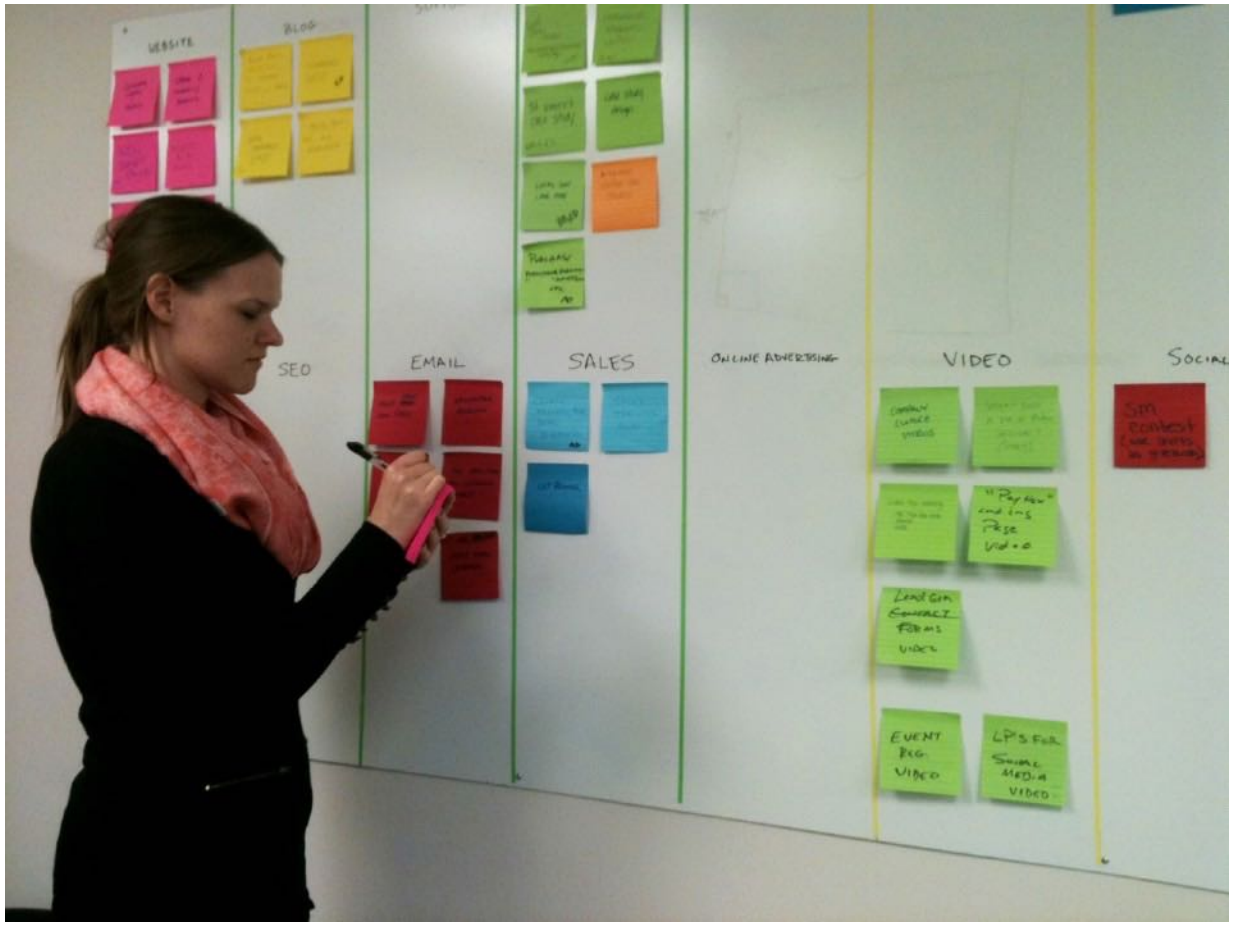


Wallboard

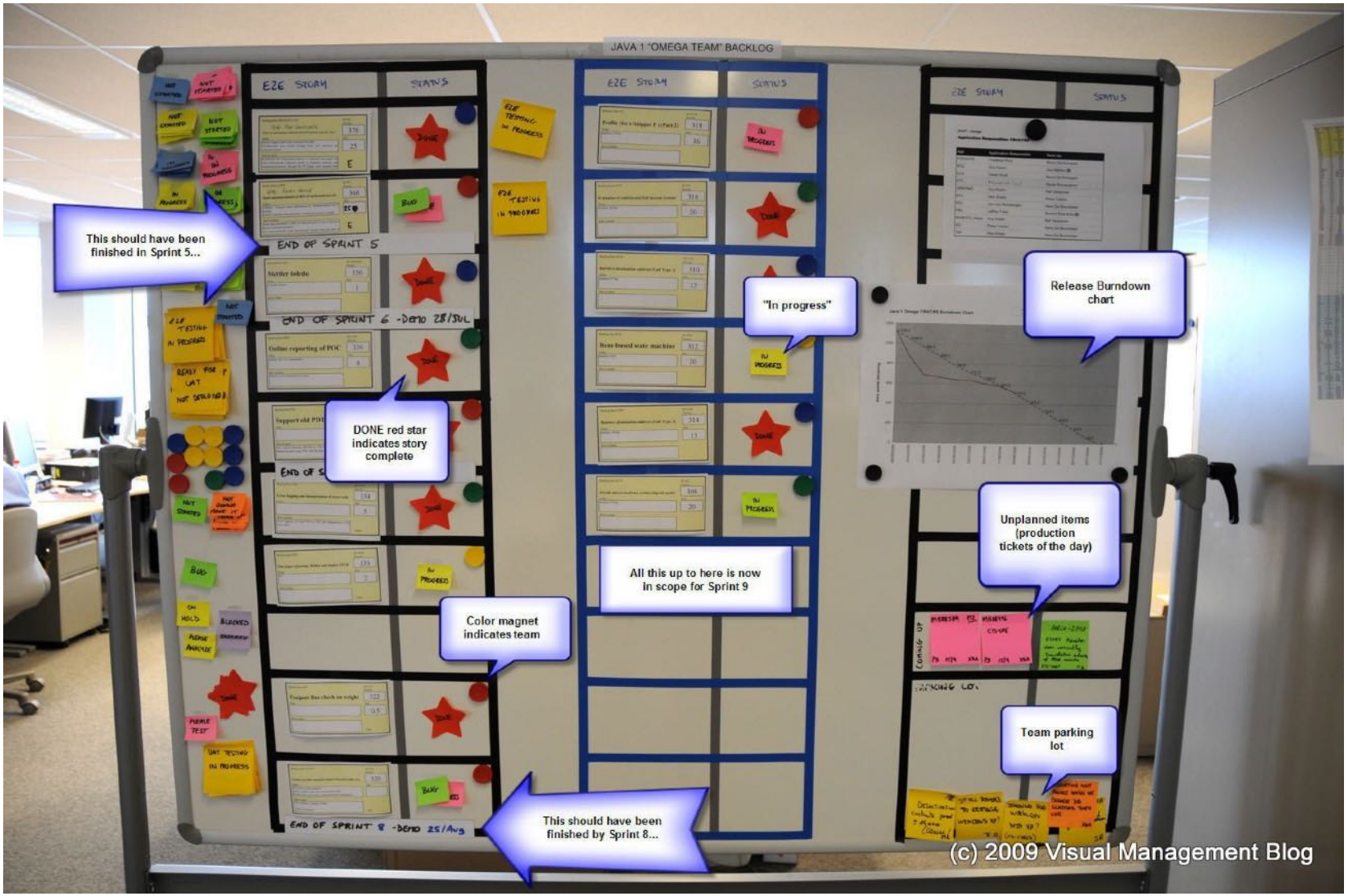
Feedback to the team

Wallboard

Feedback to the team



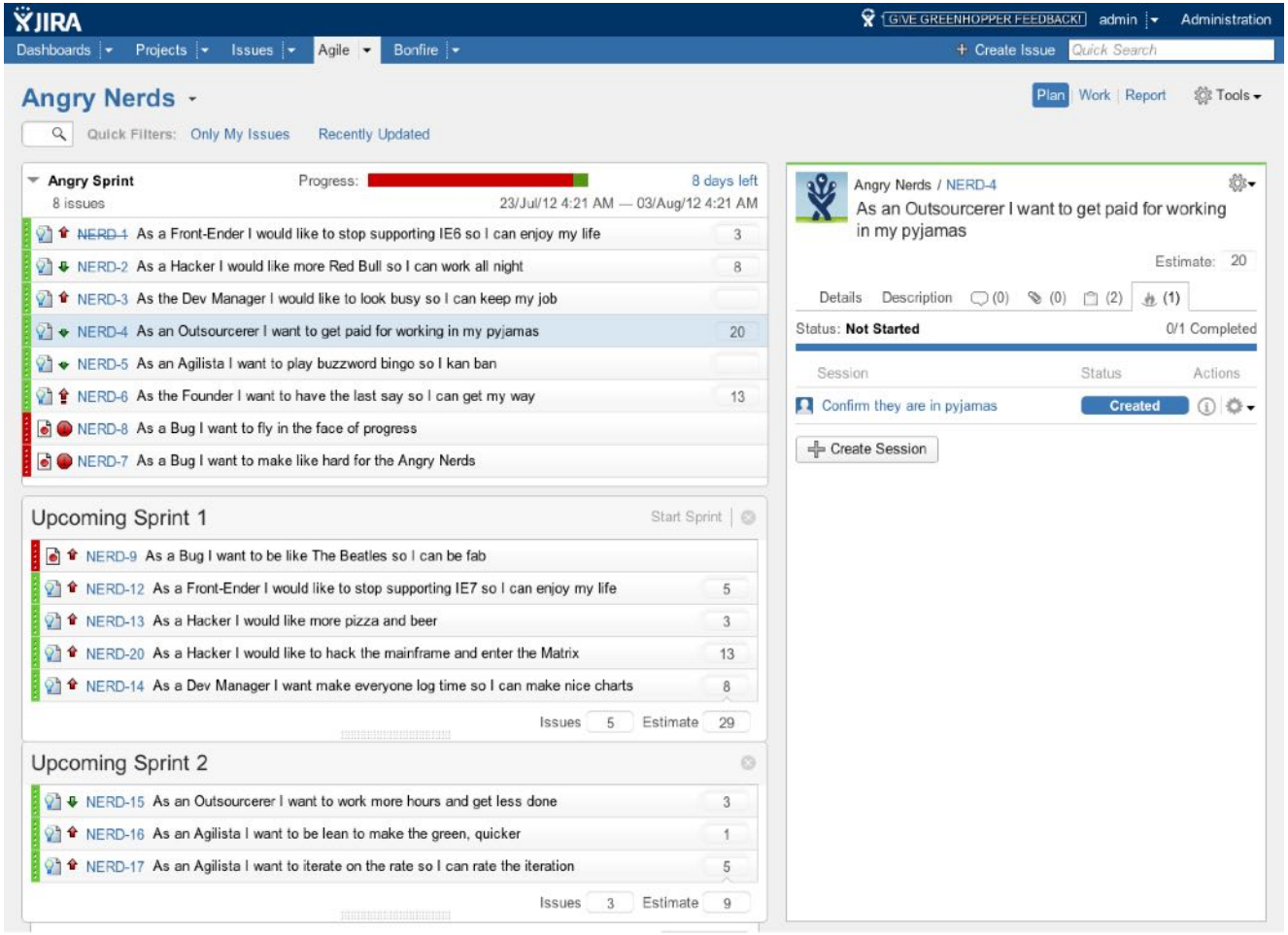
Wallboard


JAVA 1 "OMEGA TEAM" BACKLOG
E2E STORY
STATUS
END OF SPRINT 5
END OF SPRINT 6 -DEMO 28/JUL
END OF SPRINT 8 -DEMO 25/Aug
This should have been finished in Sprint 5...
DONE red star indicates story complete
Color magnet indicates team
"In progress"
All this up to here is now in scope for Sprint 9
This should have been finished by Sprint 8...
Release Burndown chart
Unplanned items (production tickets of the day)
Team parking lot
(c) 2009 Visual Management Blog

LEGO Bit planner

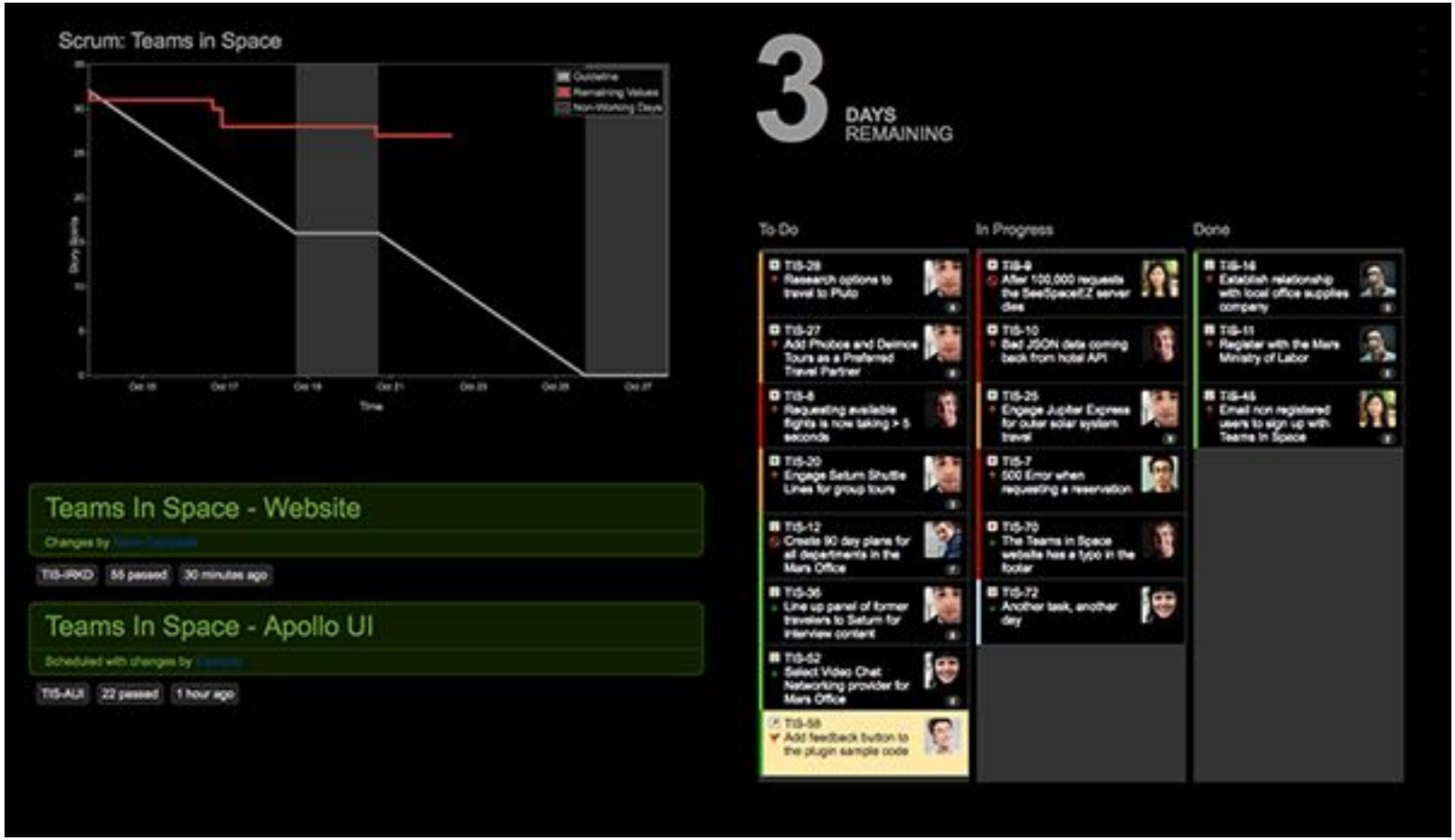
https://vimeo.com/75500464

Scrum software



JIRA - http://youtu.be/KdyV9okLRIc

Scrum software



Conclusion

Collaboration in software development

- Is necessary for large projects
- Is not obvious:
  - Technical, organizational and social aspects

Version control supports asynchronous collaboration

- Explicit synchronization between versions
- Branching: split work among developers

Conclusion

Continuous integration

- Improves safety and efficiency

Agile method

- Organizes a development team
- Proposes an adaptative process to unpredictable requirements

References

Version control

- http://nvie.com/posts/a-successful-git-branching-model/
- http://www-igm.univ-mlv.fr/~dr/XPOSE2010/gestiondeversiondecentralisee/dvcs-svn.html
- http://www.infres.enst.fr/~bellot/java/poly/git.pdf
- http://fr.openclassrooms.com/informatique/cours/gerez-vos-codes-source-avec-git/qu-est-ce-qu-un-logiciel-de-gestion-de-versions

Continuous Integration

- http://martinfowler.com/articles/continuousIntegration.html

Agile Models

- http://agilemanifesto.org
- http://martinfowler.com/articles/newMethodology.html

Pair Programming

- http://www.versionone.com/Agile101/Pair_Programming.asp

Scrum

- http://scrumreferencecard.com