Using version control to collaborate in projects

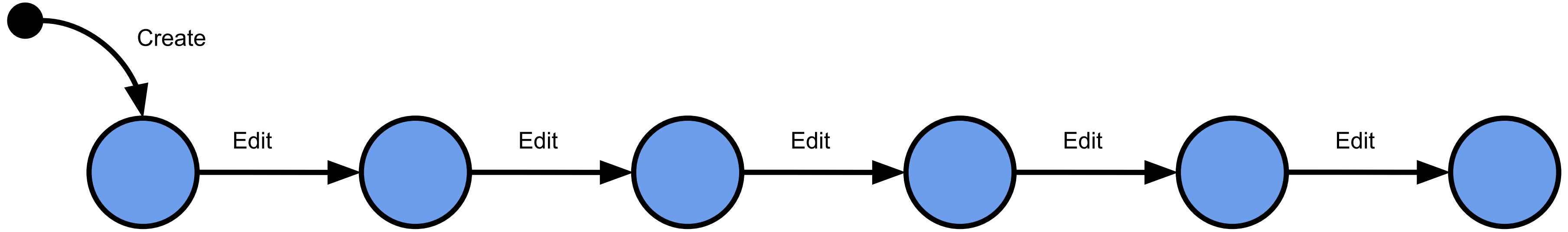
Outline

- Artifacts’ lifecycle
- Managing revisions
- Client/server vs distributed revision systems
- Managing conflicts
- Branching
- Workflows

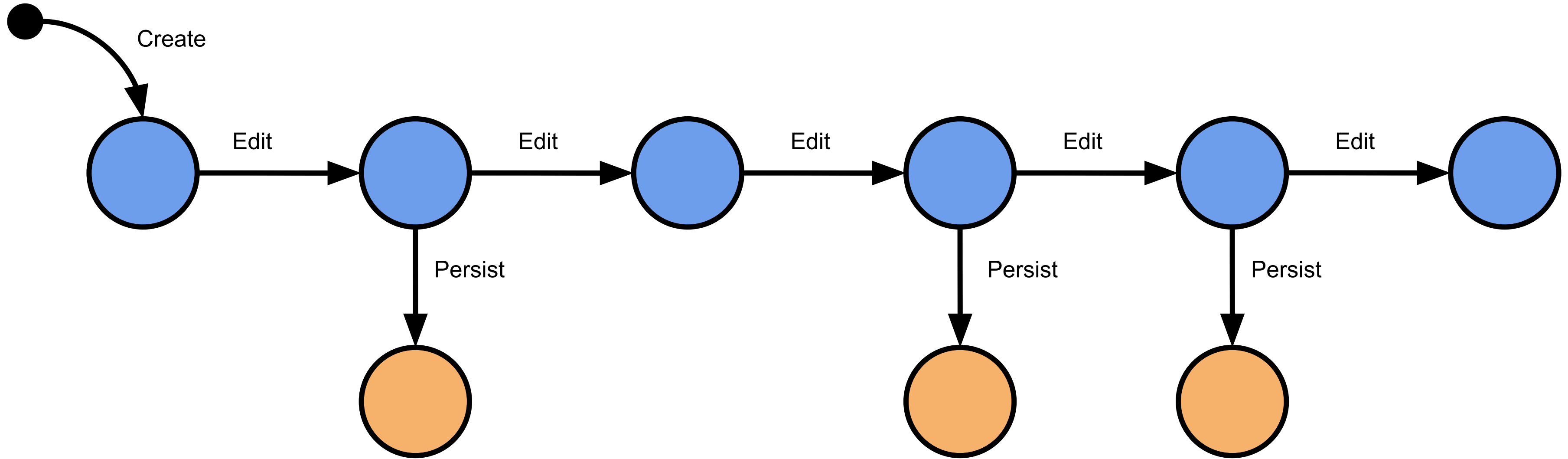
TODO

- Tags
- Head
- Merge command line example

Artifacts' lifecycle



Artifacts’ lifecycle



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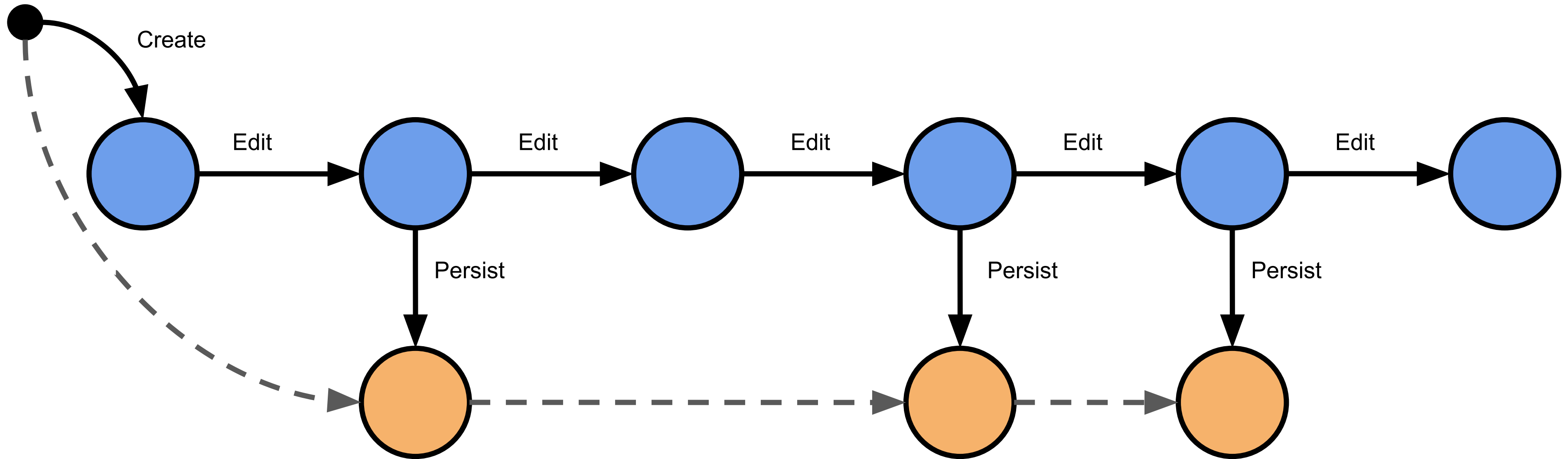
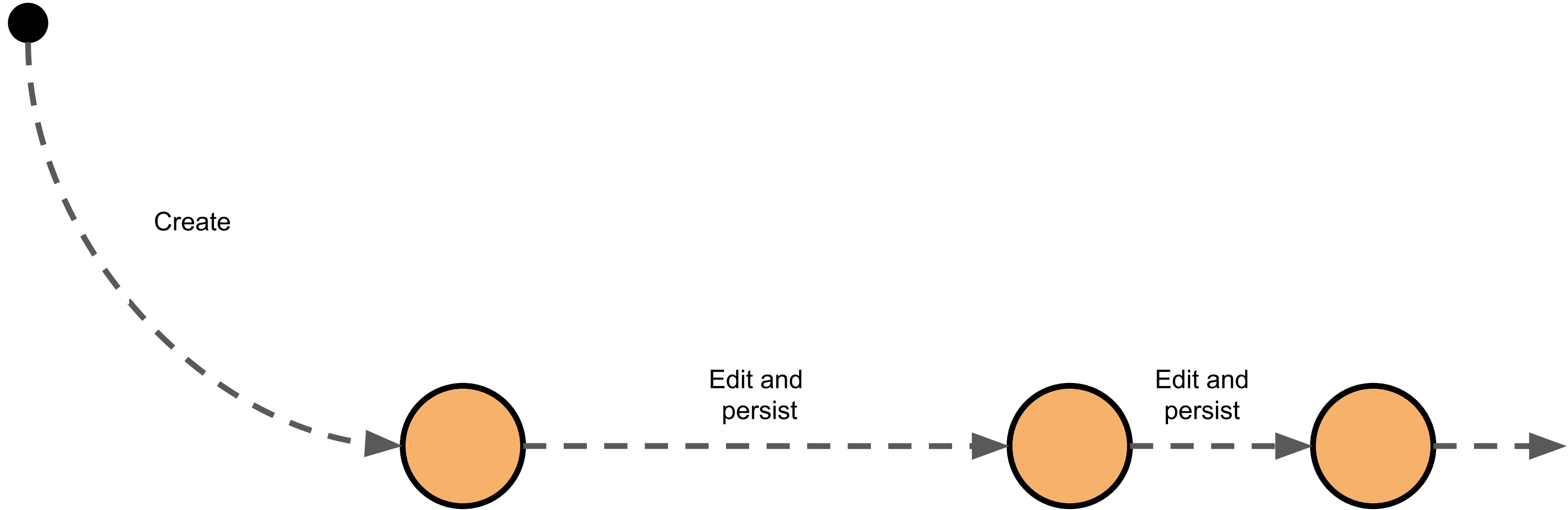


Files’ lifecycle



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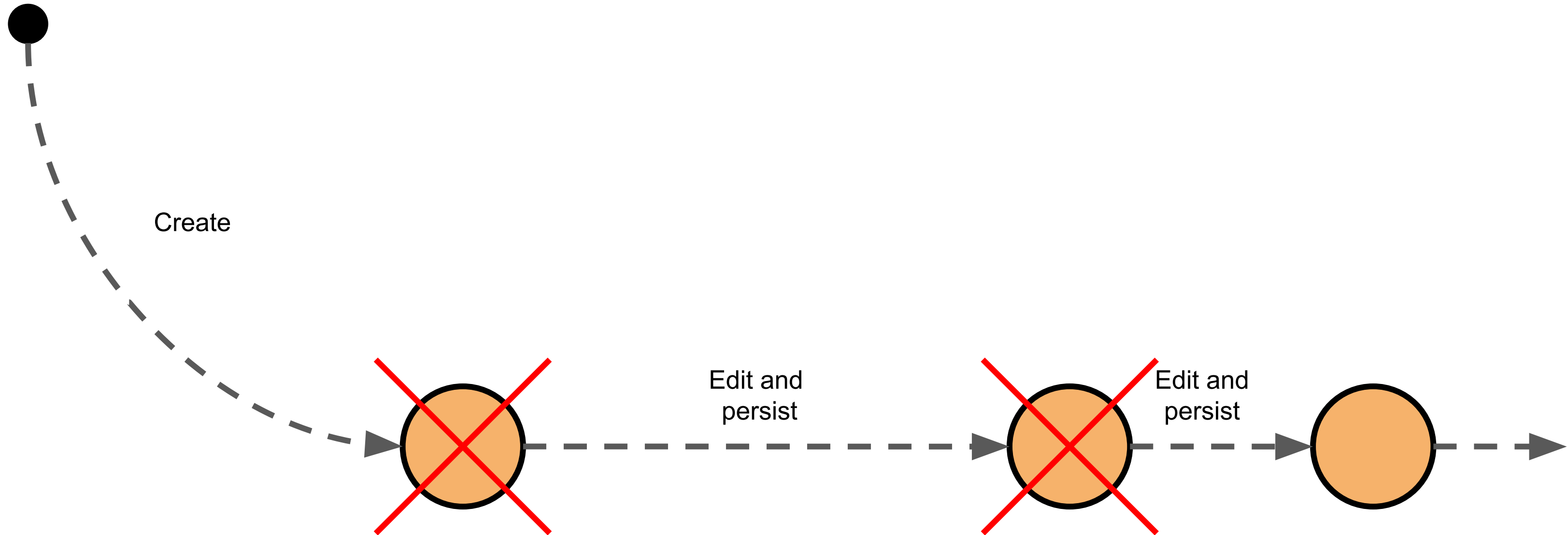

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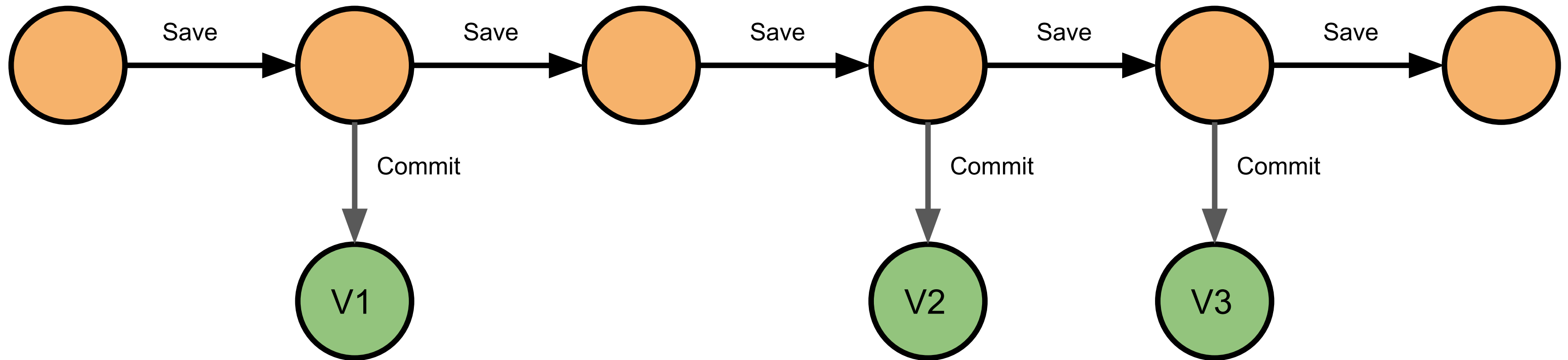

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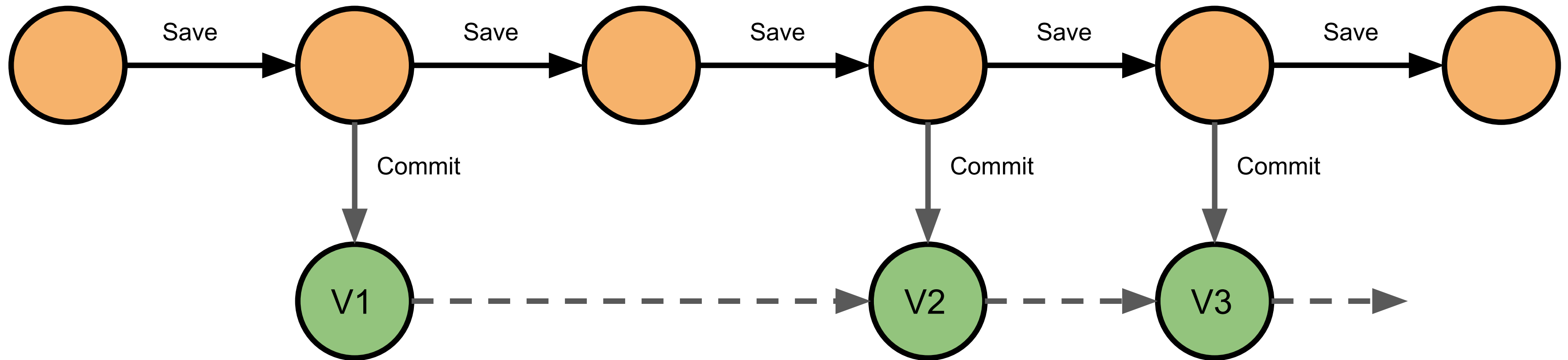


Managing revisions

- Implement a `commit` operation that makes *snapshots* of files
  - Easy to do, e.g.: move snapshots to version-stamped directories or create copies in place appending a version counter at the end of the filename or create a document database or … Let’s call this *thing* a **repository**.
- Implement a `restore` operation that retrieves previous snapshots
- We’re done, right?

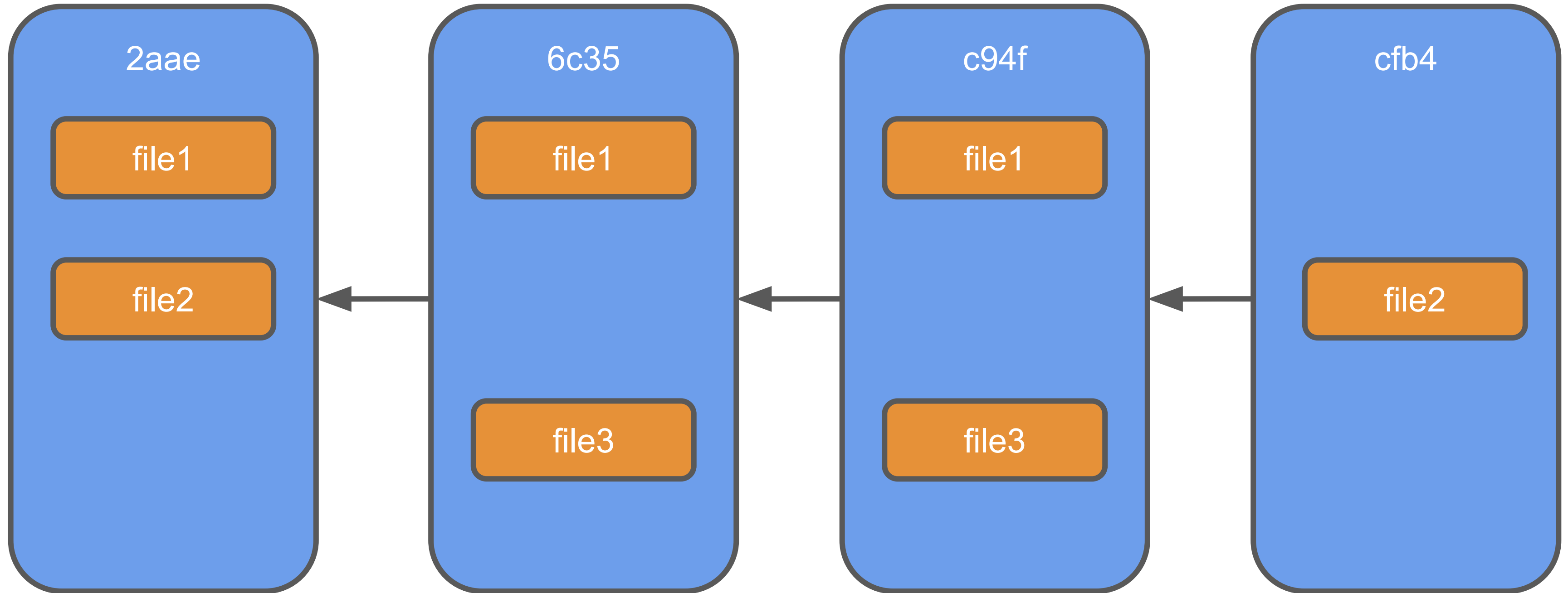
Additional issues

- Metadata
  - When was the snapshot taken?
  - Who edited the file?
  - Why they did it?
- Changesets
  - Are other files involved in the same conceptual change?
- Collaboration
  - How to deal with changes from different developers?

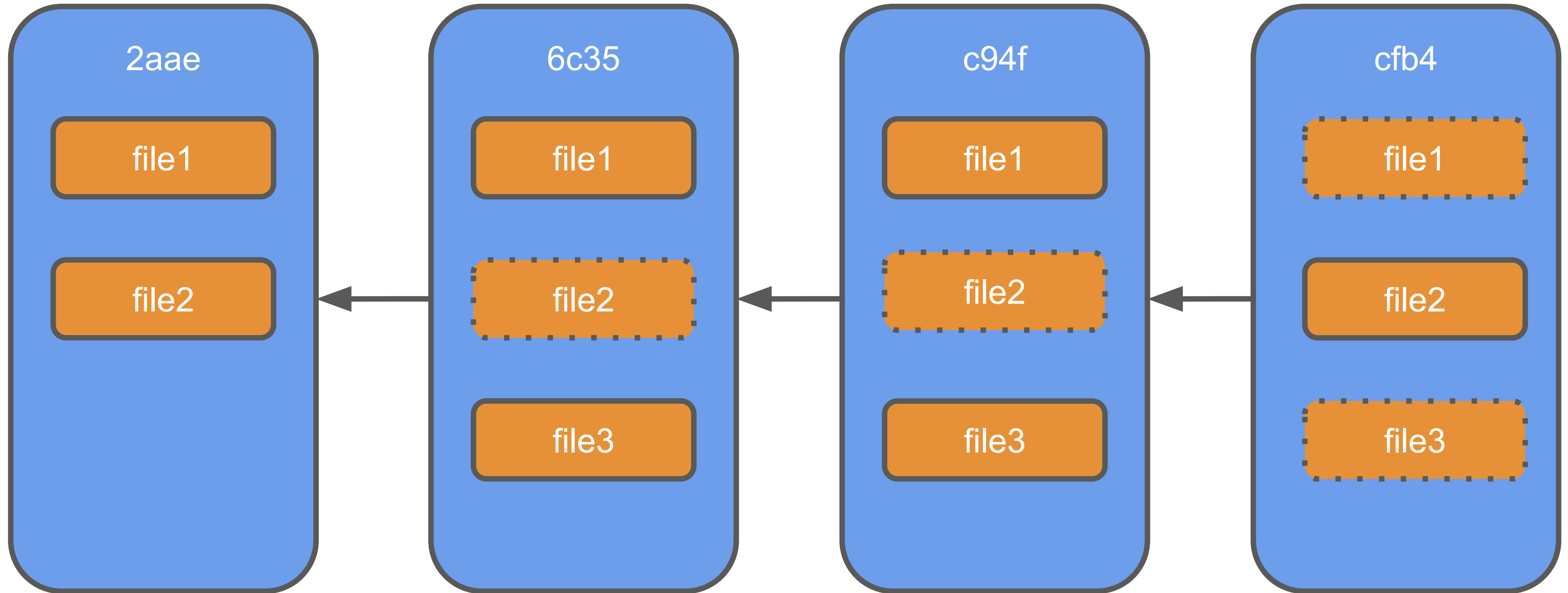
The changeset

When creating revisions we often want to operate not on single files but on a group of correlated files that have all been modified as part of the same conceptual change. This group of files is usually referred to as a *changeset*.

The stream of changesets



The stream of snapshots

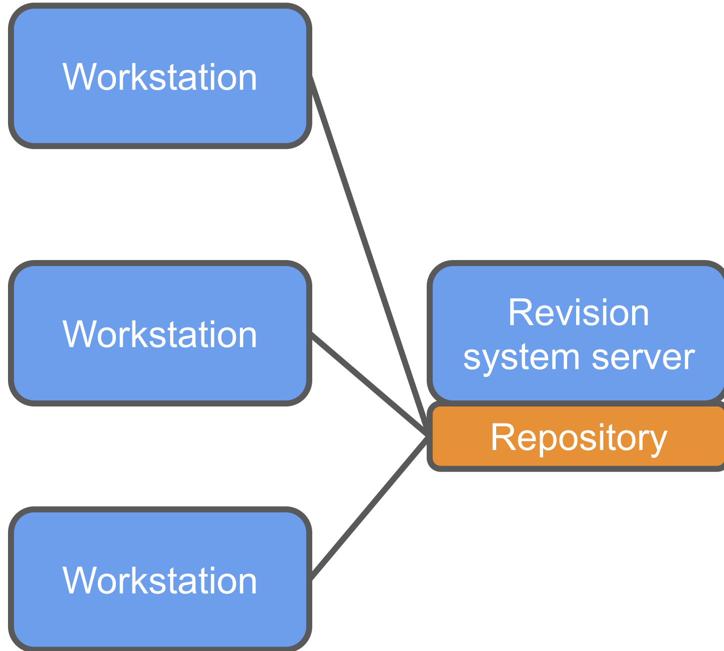


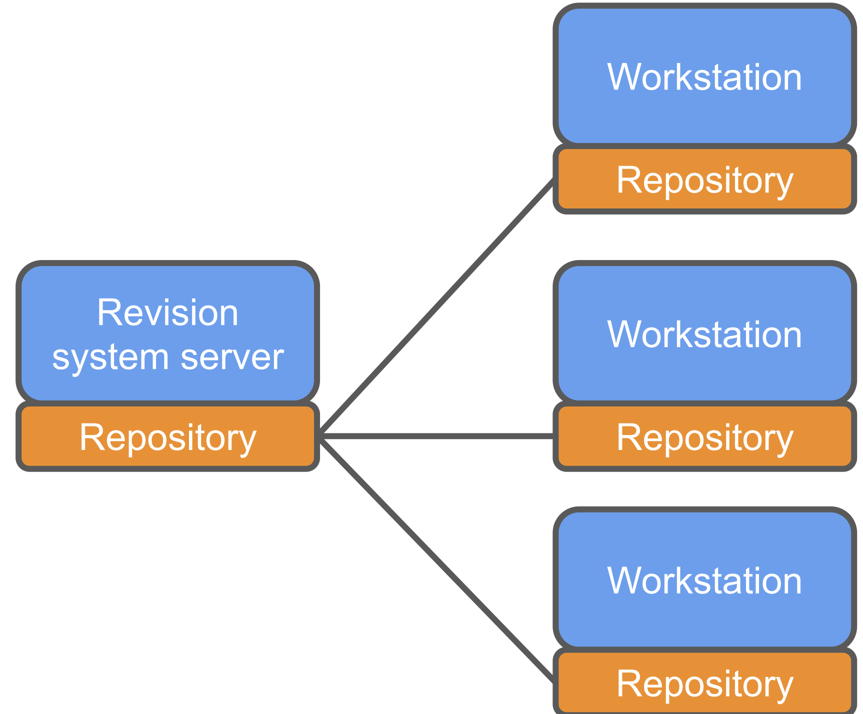
Collaboration

Make the revision system a distributed system.

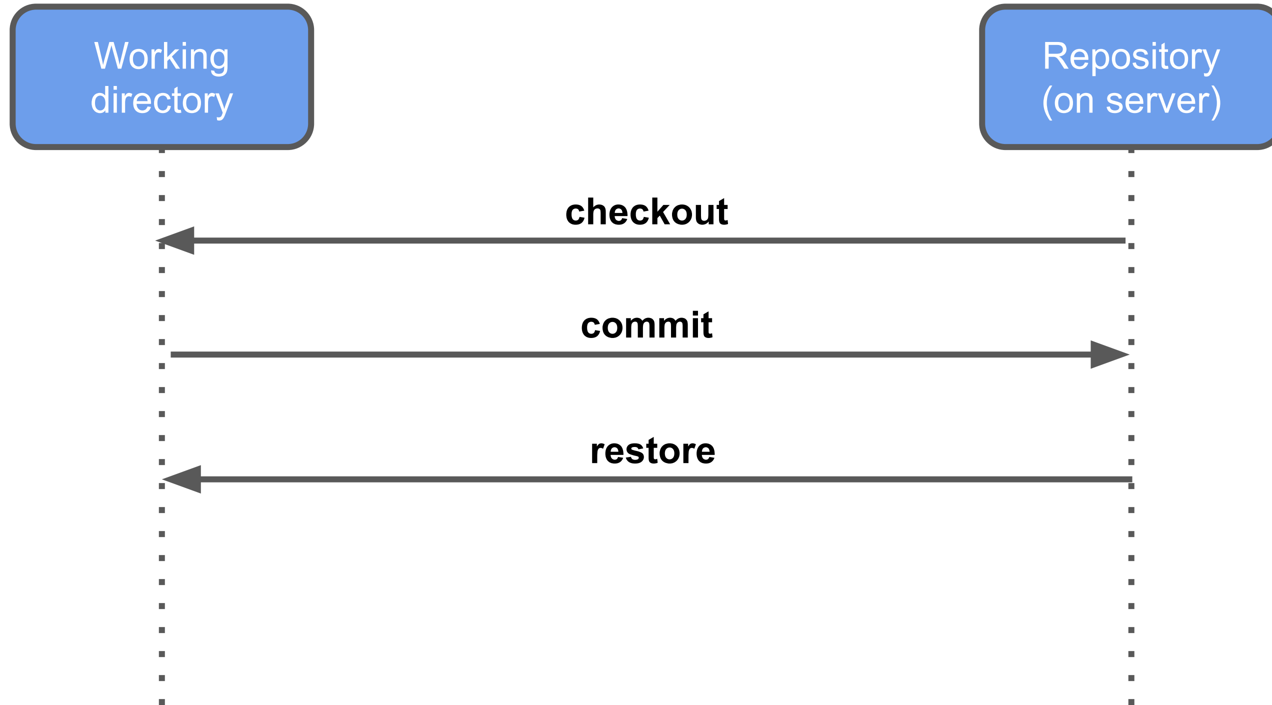
- Client/server (*centralized*) approach - the revision system runs as a service in a remote host and exposes an API.
- P2P (*distributed*) approach - all workstations have local repositories that can be *synchronized* with remote repositories.
  - Most usually: one remote repository and multiple local repositories that synchronize with the remote one

Centralized vs distributed

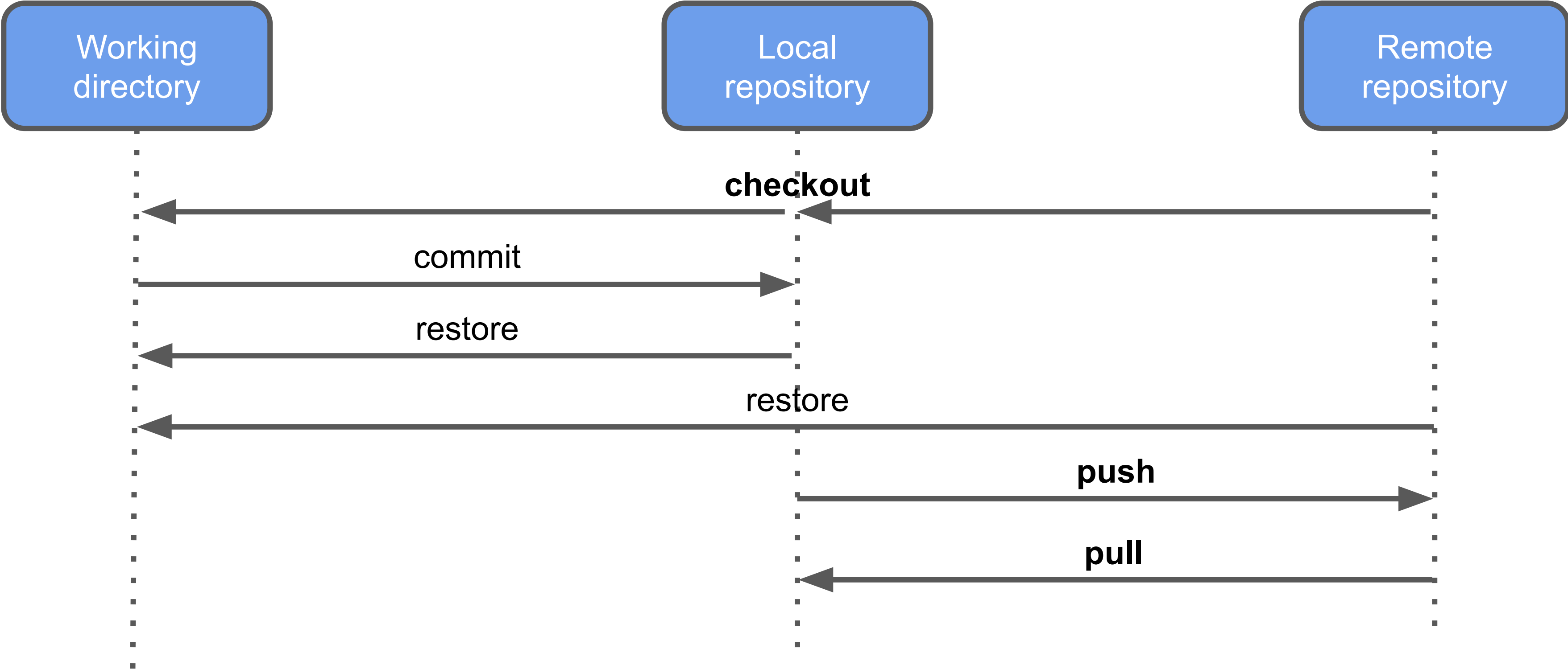




Centralized revision system



Distributed revision system



What could ever go wrong?

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Conflicts: multiple users modify the same file(s) concurrently.

Conflicting histories in distributed VCSs

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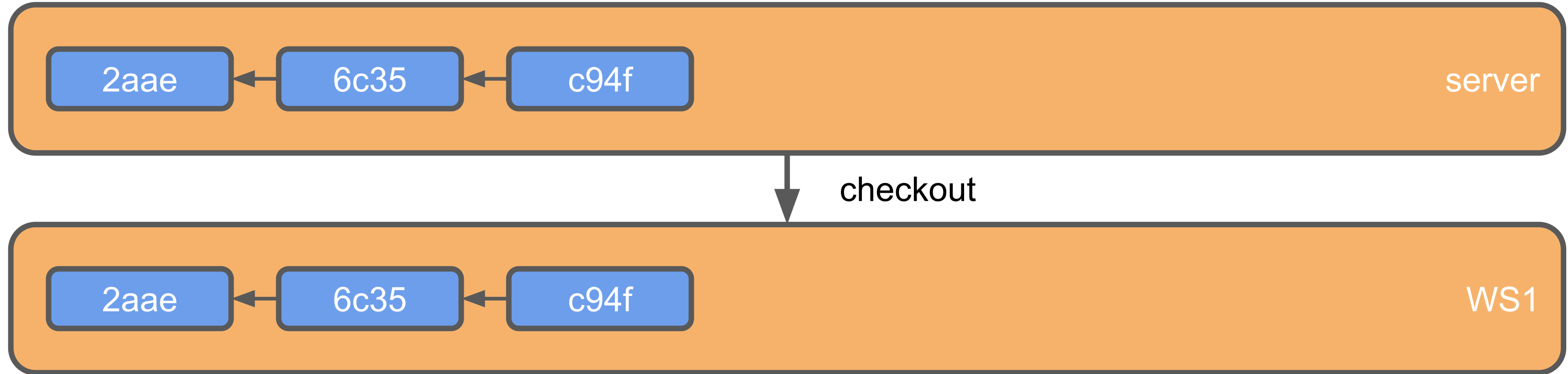

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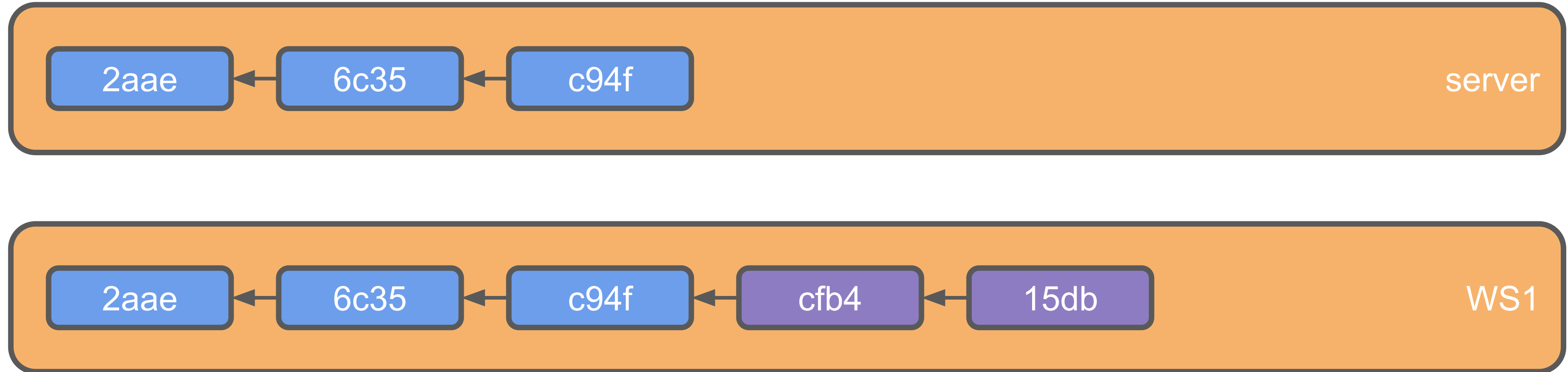

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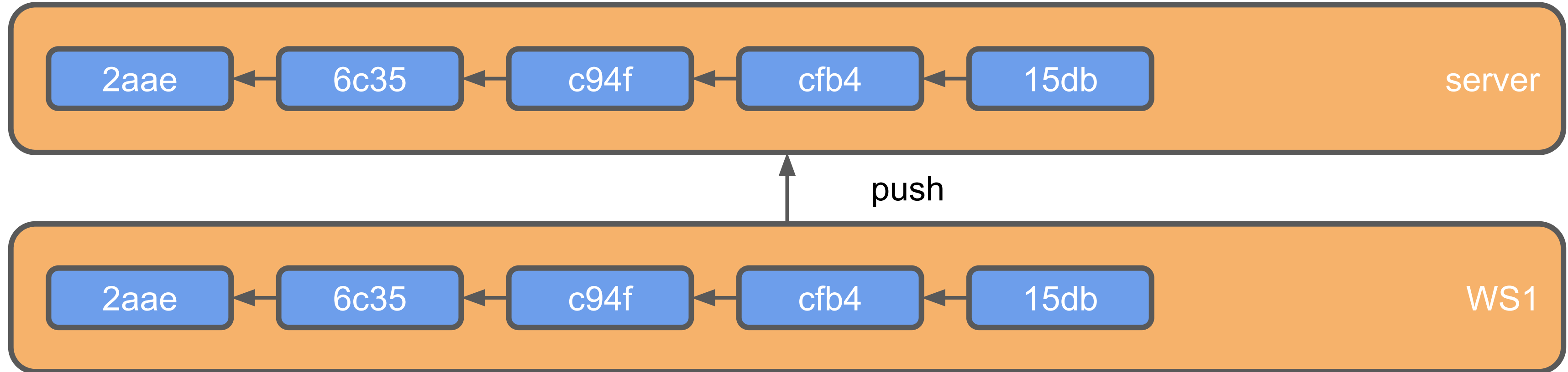

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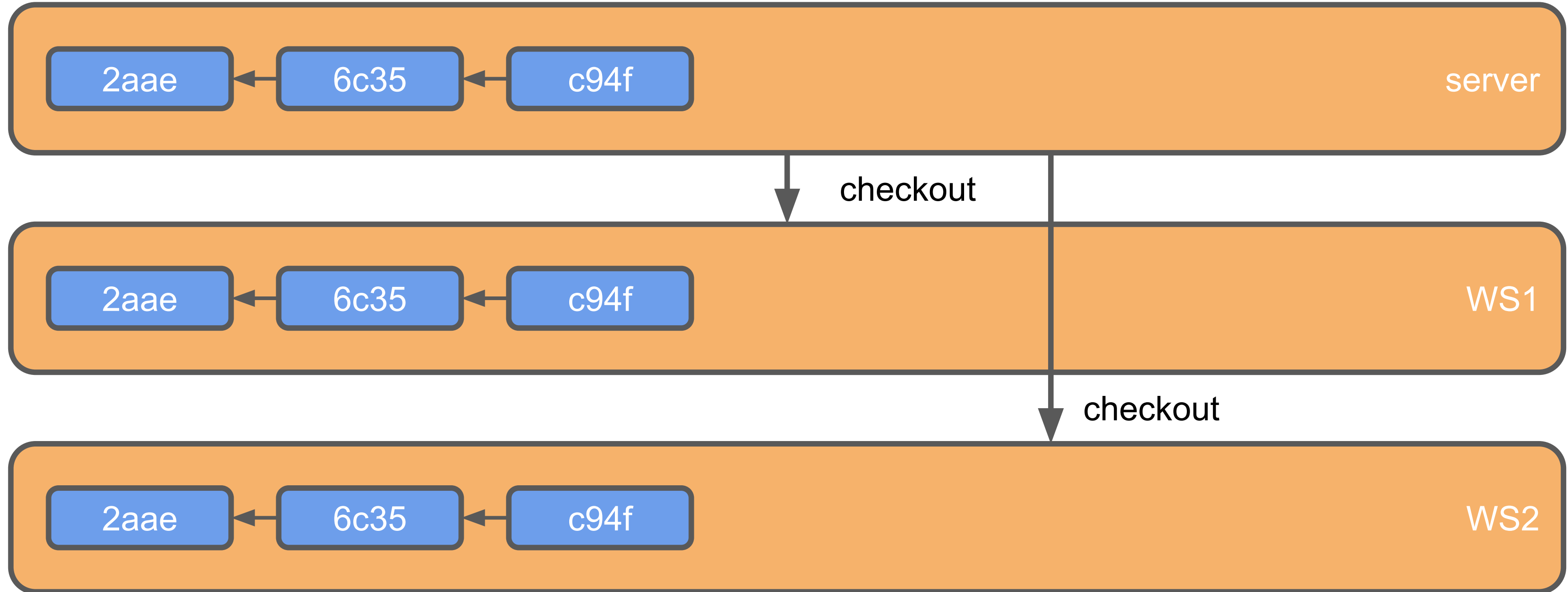

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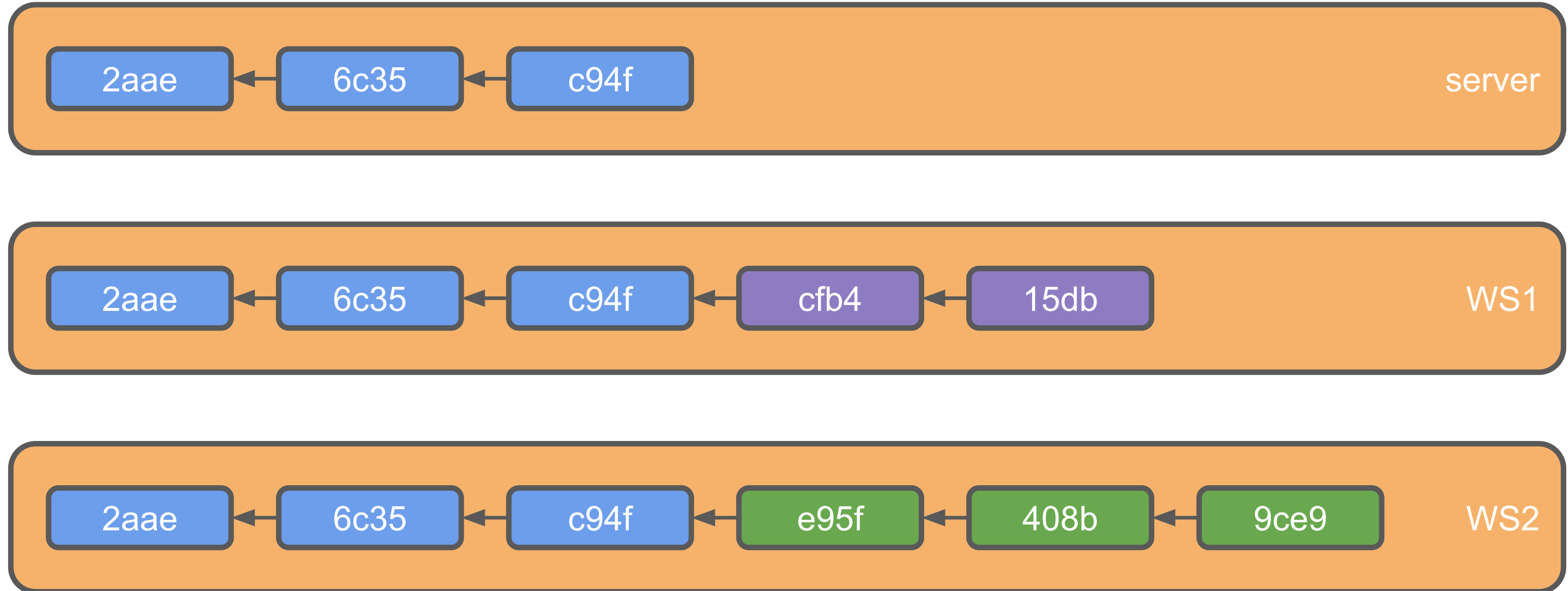

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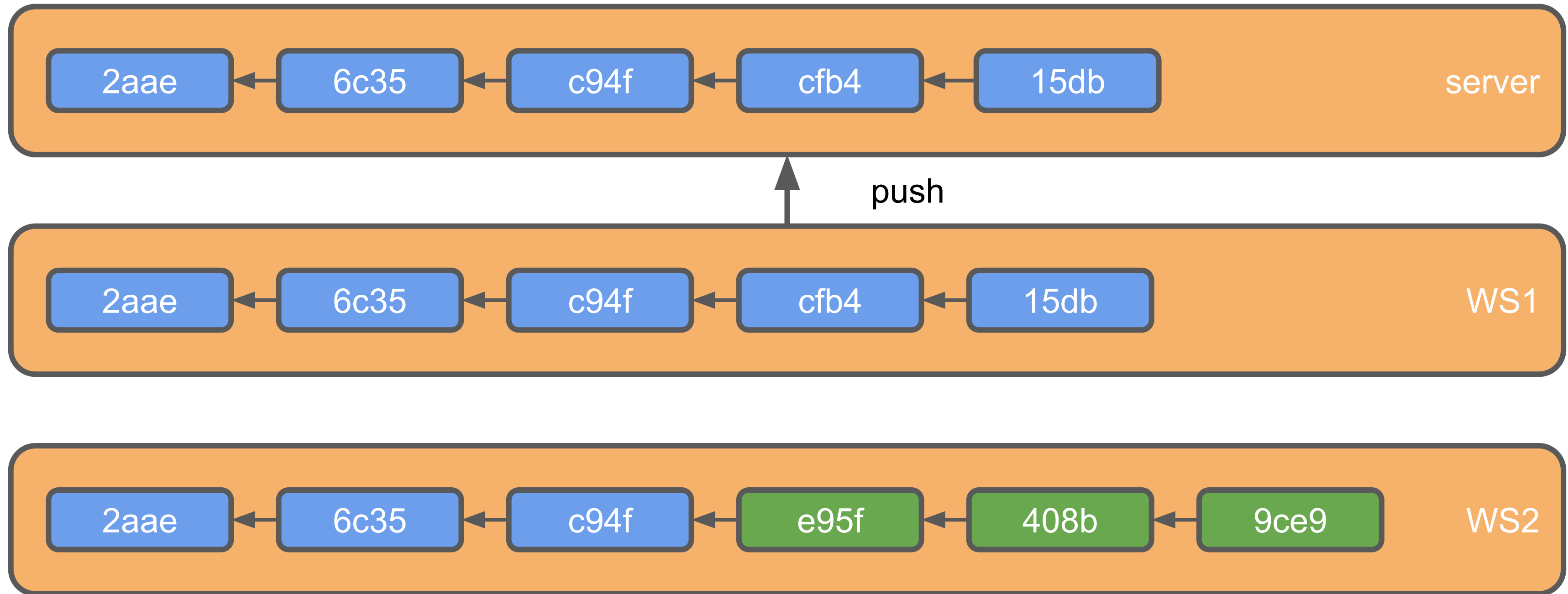

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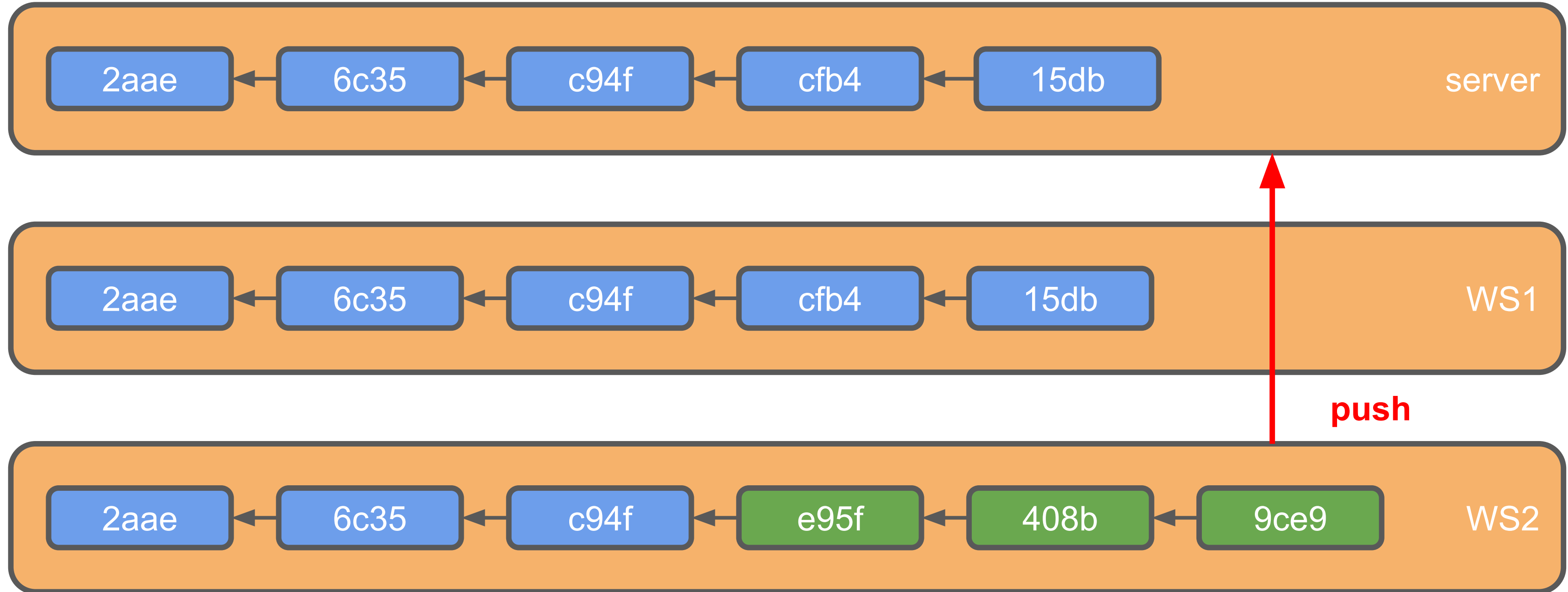


Facing conflicts

- Centralized approach: avoid them
  - Use locking: only the user owning the lock for a file can create revisions for that file.
- Distributed approach: manage them
  - Define *workflows* to minimize the impact of conflicts; when concurrent changes happen, select a change over another or *merge* changes.

Issues with the client/server approach

- Everybody sees everybody’s revisions also if that’s partial work.
- If somebody forgets to release a lock, it’s a problem.
- Bad habits with lock management impact all developers.
- If the server is *down* everybody is stuck.

git

Git (*noun*): an unpleasant or contemptible person.

[Oxford Languages]

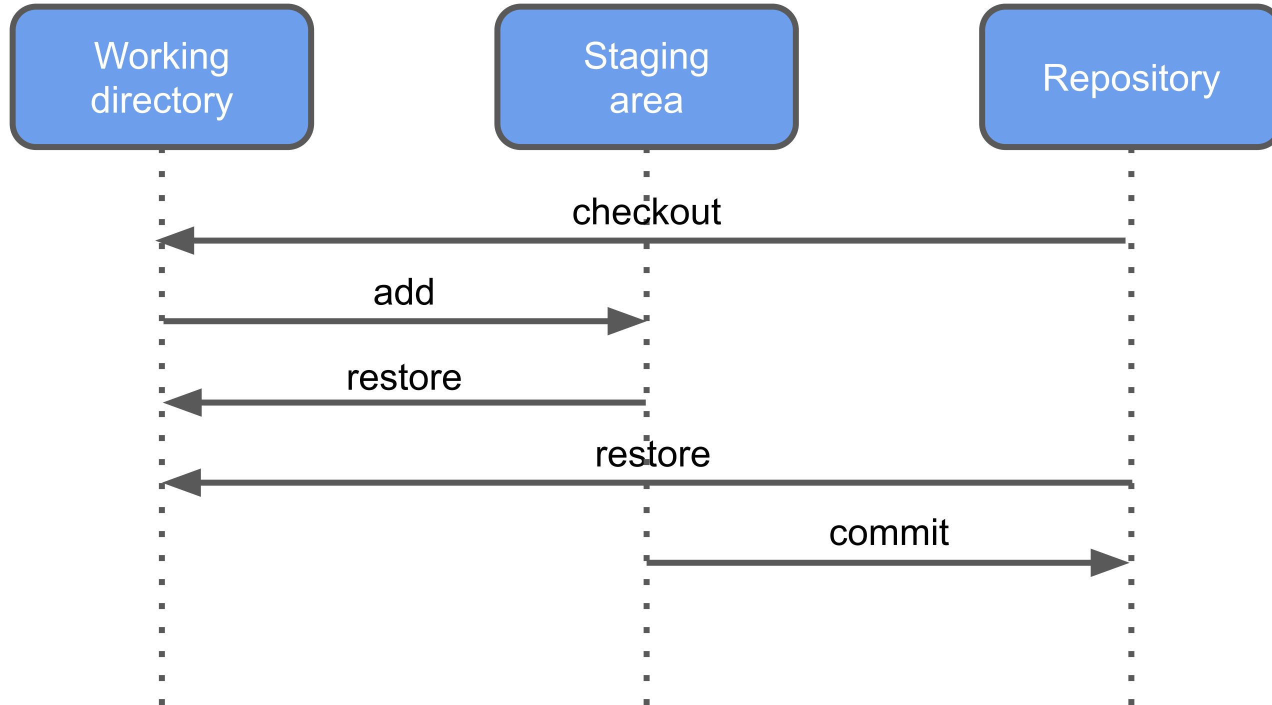
Originally developed by Linus Torvalds in 2005 to support the collaborative development of the Linux kernel. Main design goals: efficiency (esp. w.r.t. branching), robustness.

git

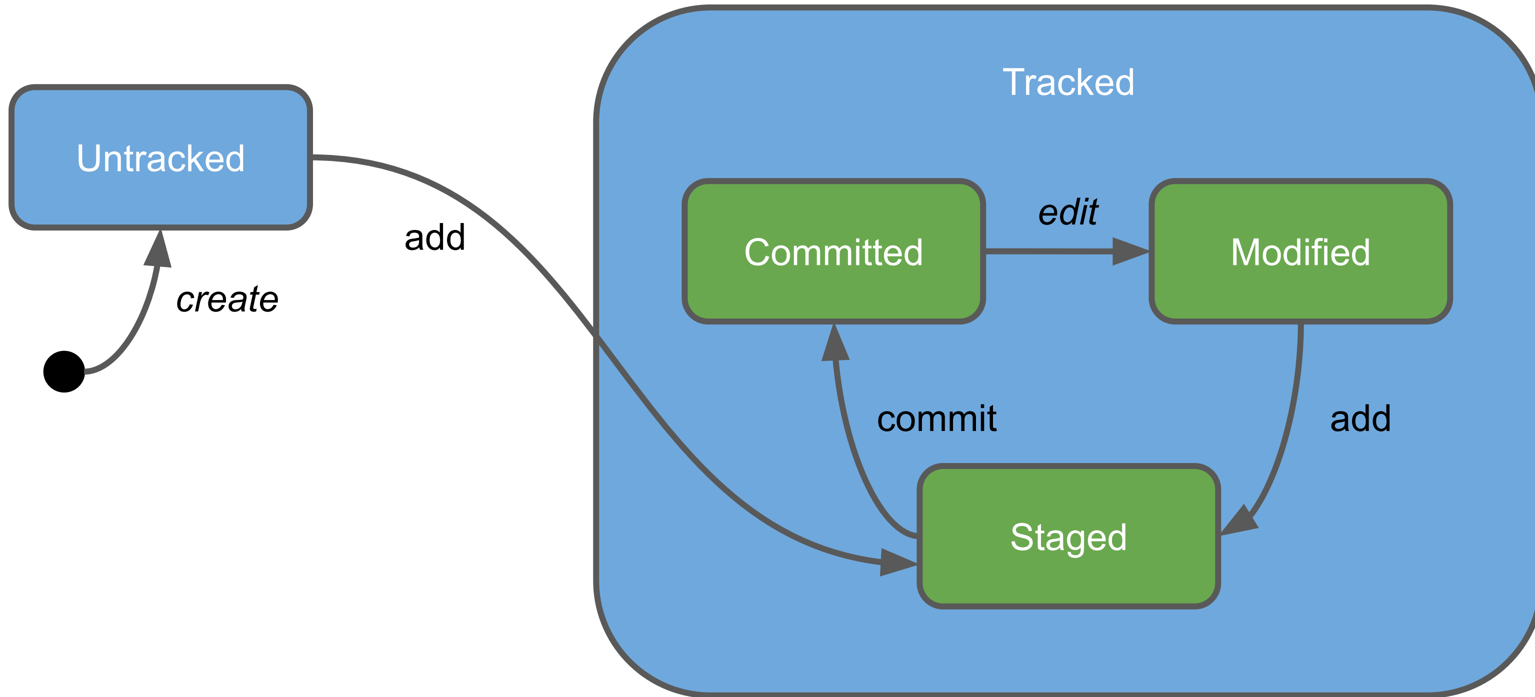
git is a distributed versioning systems, initially devised as a *kernel* on top of which user-friendly versioning systems could be built.

The user friendly systems, however, never appeared.

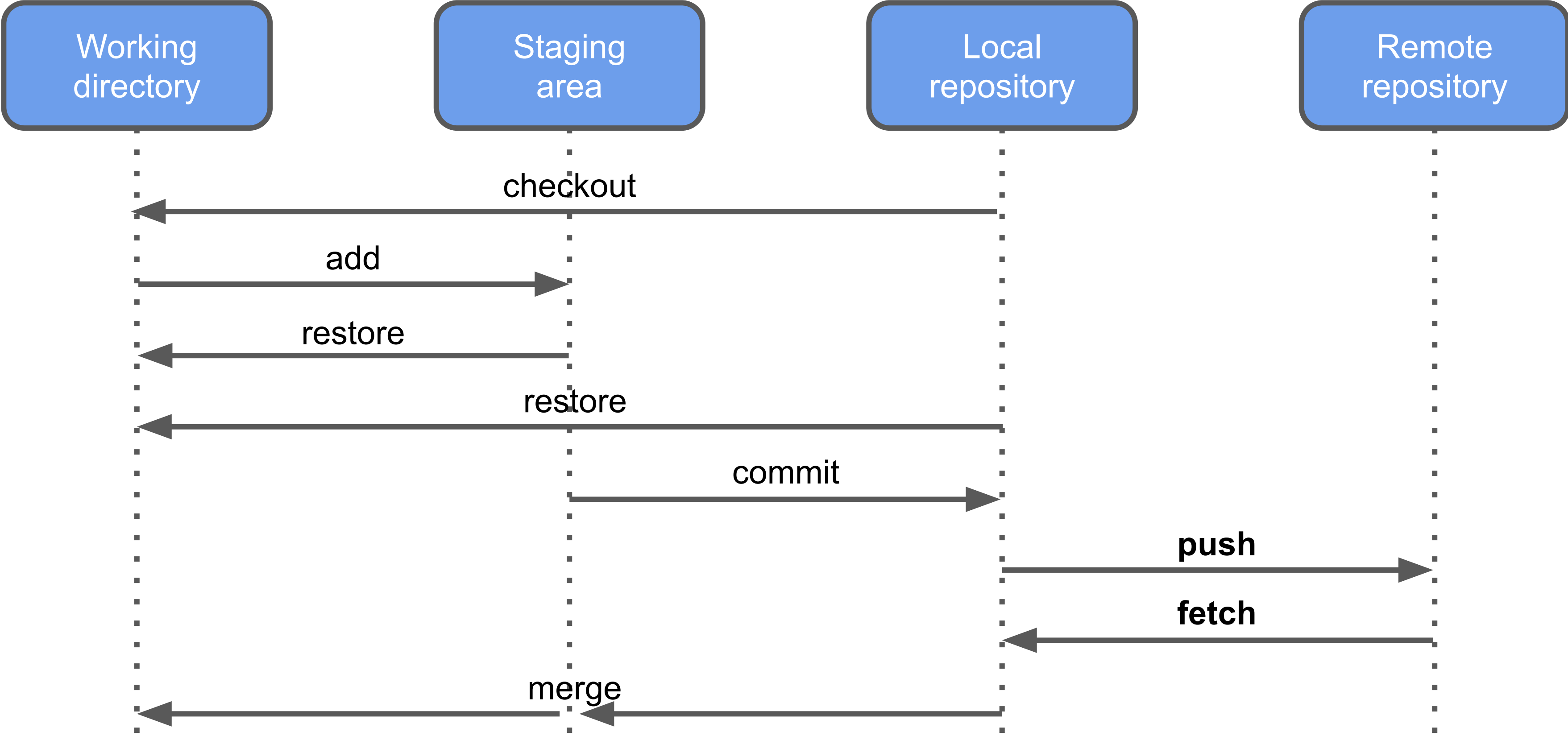
git: the areas



git: the states

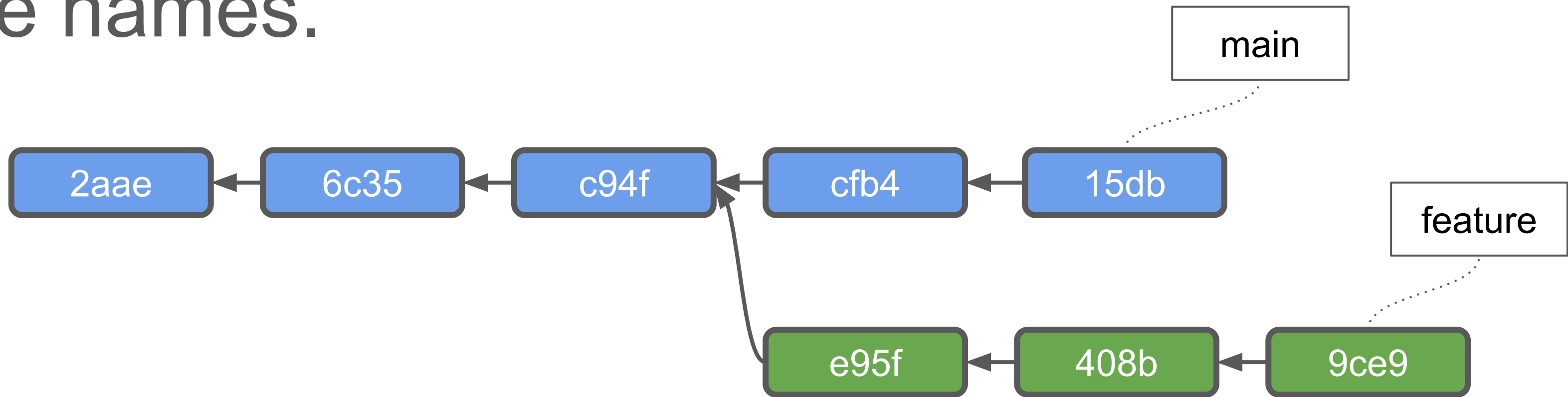


Distributed git



Branching

A branch is a history line diverging from the main one. Branches have to be created explicitly and have names.



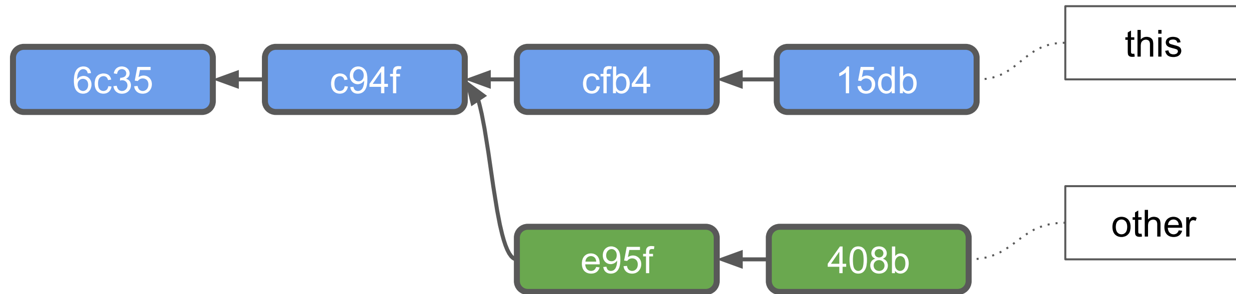
Branches

- Branches form hierarchies:
  - Child branch.
  - Parent (or upstream).
  - Trunk (parent less branch).
- Divergent branches can later be merged (i.e. integrated with an ancestor).
- A branched not intended to later be merged is usually called a *fork.*

Reconcile diverging histories

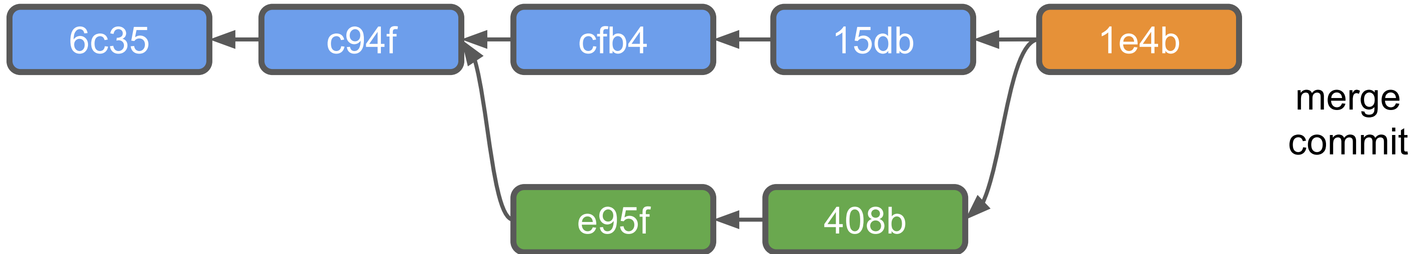
Integrate changes from diverging history lines into a single timeline.

Two main approaches: merge and rebase.



Merge

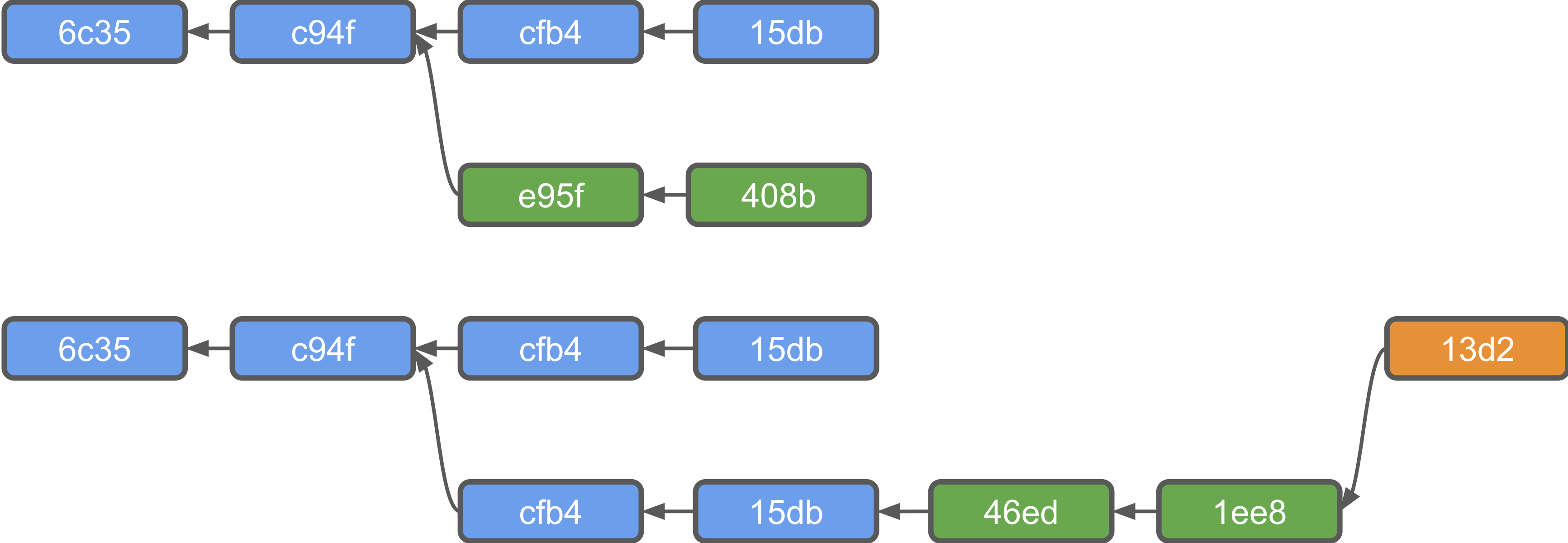
Merging creates a new commit with two parents that integrates the changes from both branches.



Types of merging

- Merging with non overlapping changesets.
  - Create a new history by applying (from a common ancestor) first the changes in *other*, then the changes in *this*.
- Merging with overlapping changesets
  - The same files have been modified in both histories.
    - For text files: if the edits are not overlapping, apply them all.
    - In all other cases: no automatic fix, let the user decide how to resolve conflicts (potentially creating a new revision).

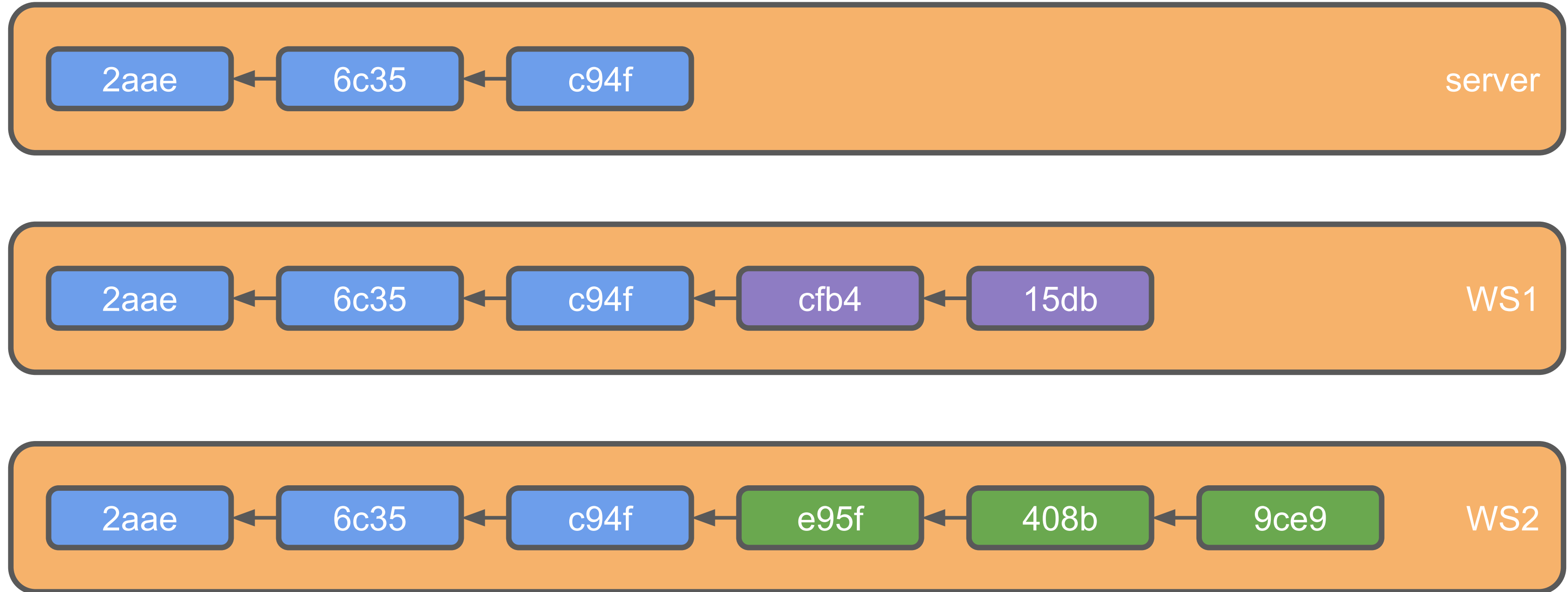
Rebase



git centralized workflow

- No branches.
- When conflict takes place (during push operations) align local history with remote's (e.g. rebasing with `pull --rebase`) and push again.

git centralized workflow



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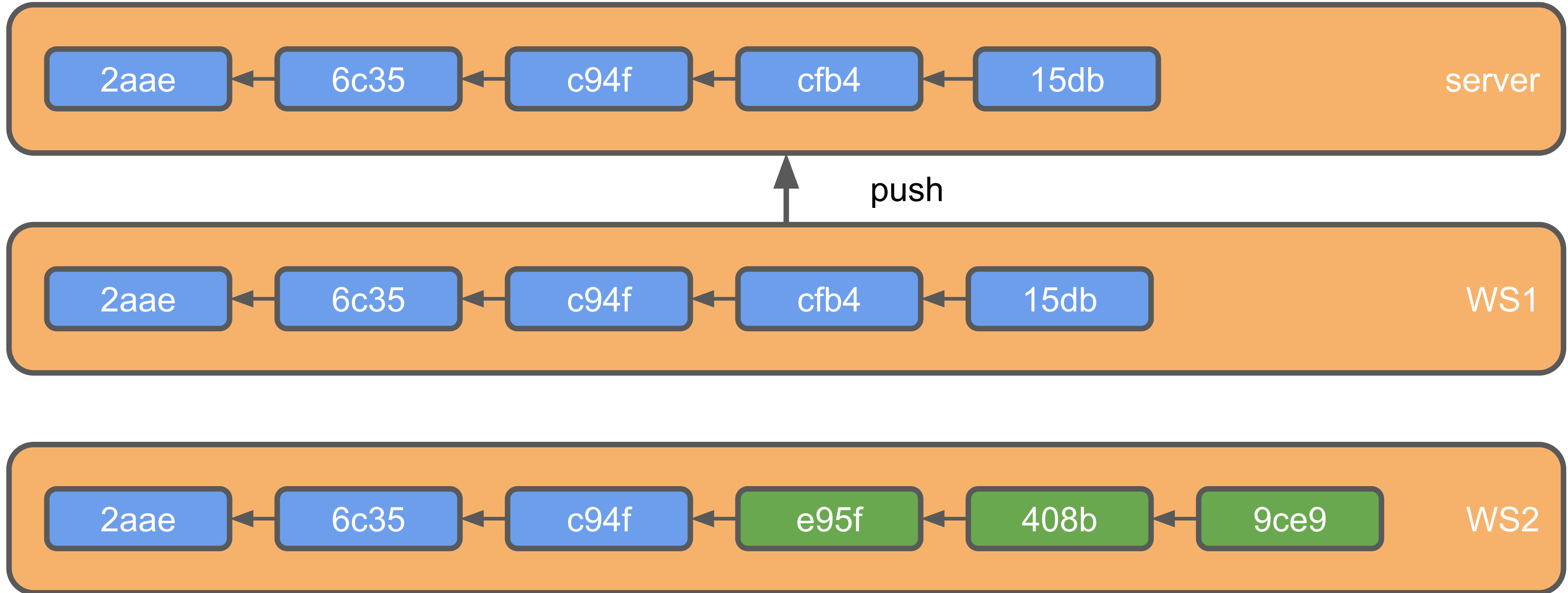

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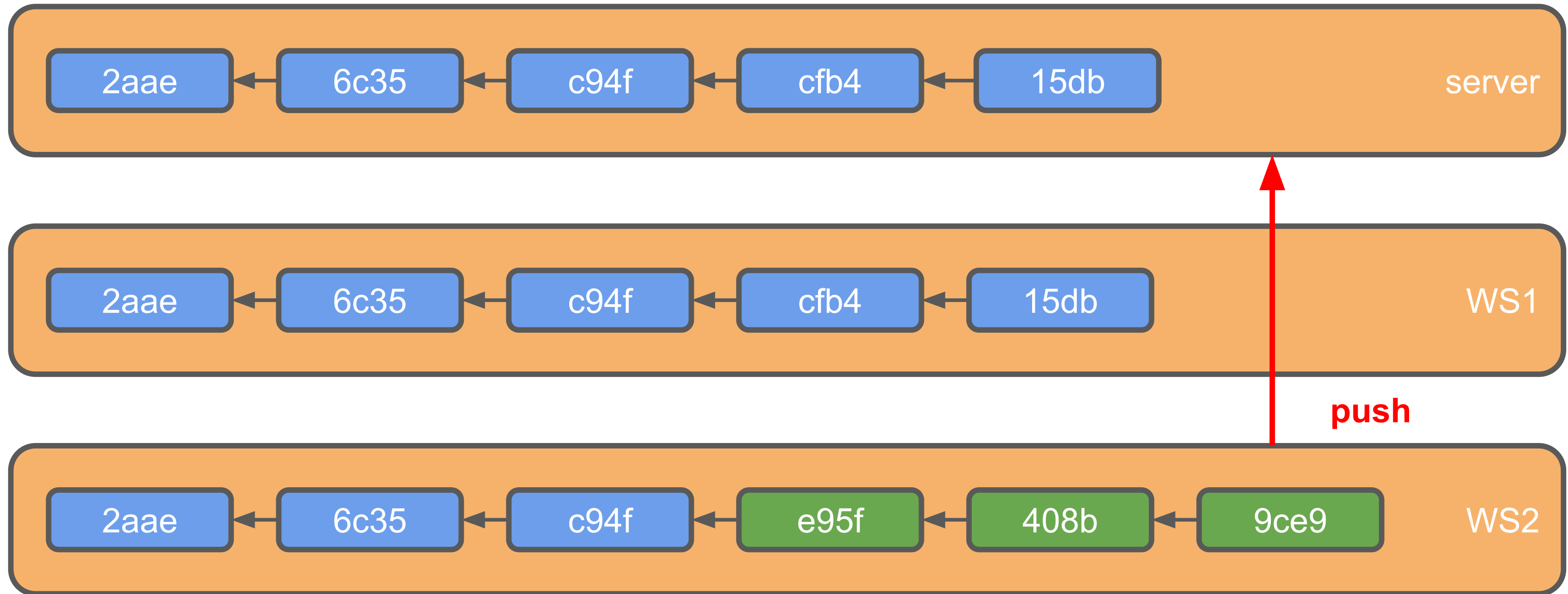

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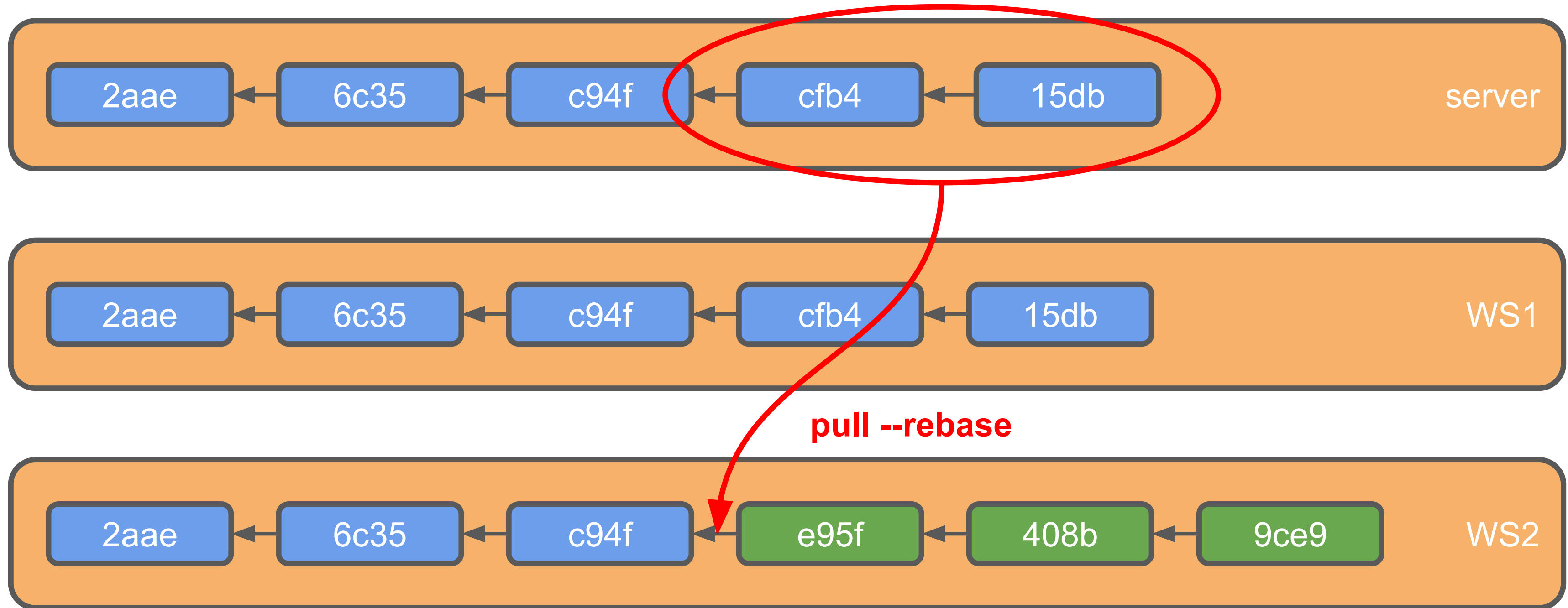


Centralized WF: conflict resolution

```
> git pull --rebase
```

```
> git log
```

```
<list of conflicting files>
```

“Fix” the conflicting files

```
> git add <fixed files>
```

```
> git rebase --continue
```

```
> git push
```

git branching workflows

Several *branching workflows* have been proposed, mostly as variations of *feature branching*.

In feature branching developers working on new features create a branch, commit to this branch until their work is done, then the branch is merged (and removed).

Pull requests

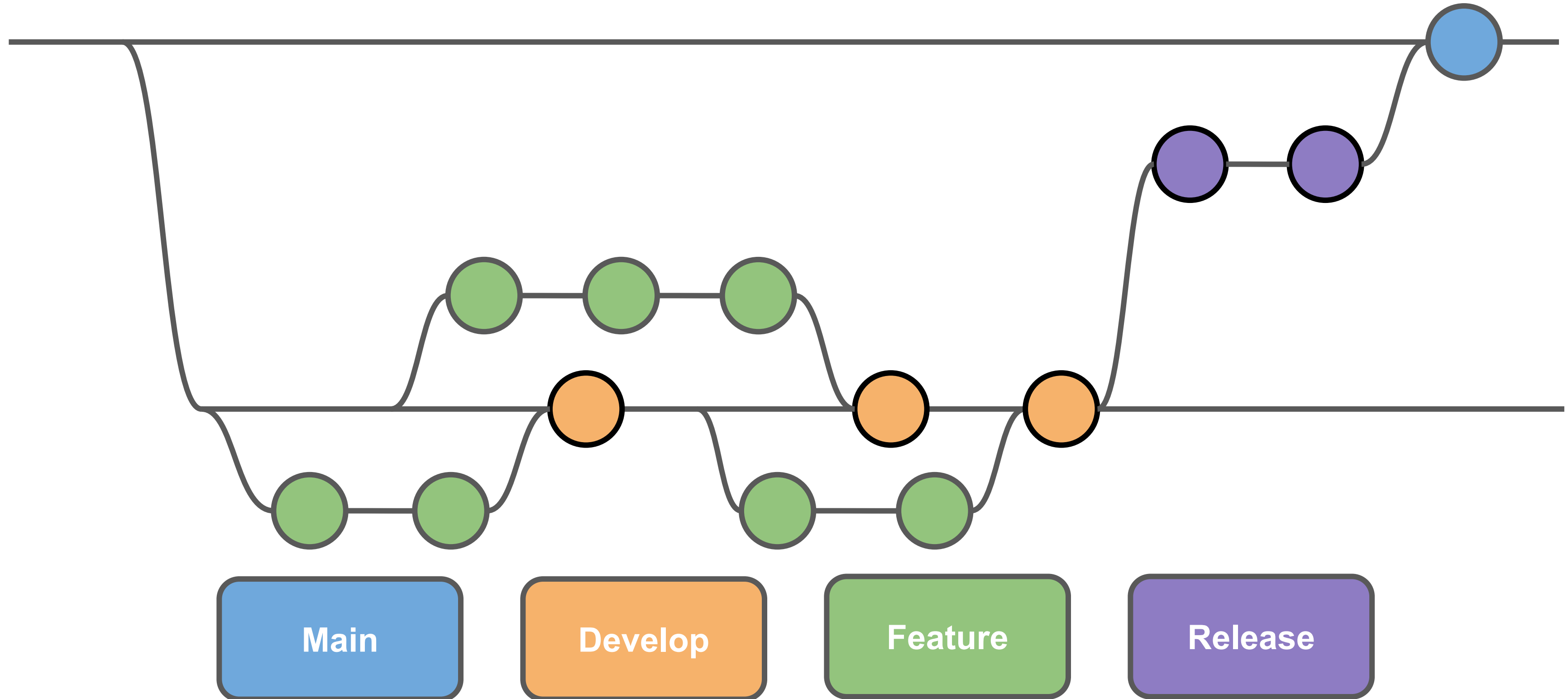
A pull request (or *merge request*) is a *practice*, it is not a technical feature of the VSC.

When adopting pull requests, the merging of a feature branch is not performed by the developer working on the branch but by a *repository maintainer* (possibly after a *review process*).

Gitflow

- Two main (historical) branches: **Master** and **Develop**.
- **Feature** branches derive from Develop (and are merged with it).
- When getting close to a release a **Release** branch is derived from Develop; no new features are committed to a Release branch; when ready to ship Release is merged with Master.

Gitflow



Gitflow: hotfixes

Hotfix branches are the only branches derived from Master; they are used for bug-fixing only and soon merged back.

Gitflow: hotfixes