Frontend

General

- The header *must* contains logo, title and current information, as well as the call to action for voting.
- A navigation bar at the left side *must* list all available top level pages.
- Lower level pages *must* be accessible via dropdown menu. These menus must work even without JavaScript.
- The UI *must* work in all current Browsers with a browser market share of more than 0.5%
- The UI *should* be responsive. Markup for mobile and desktop sited must be the same. CSS and JavaScript assets may vary.
- The UI *must* presented in a neutral way, not favouring certain results, candidates, parties or opinions
- All listings of any kind *must* be alphabetically sortable, ascending and descending.
- The UI *should* be evaluated by heuristic criteria.

Analysis & Information

- Results *must* be displayed as graphs.
- Additional tabular information *must* be available for display.
- When JavaScript is disabled a fall-back *must* exist. The tabular information being the default option.
- Concerning the types of graphs see the Lastenheft and Wahlanalysen documents.
- Map based results *should* use an SVG graphic for display and interaction.

Voting

- The voting ballot *must* be a separate page. It should be able to show it as an inline frame on the information page.
- Authorization to vote *must* be done using the ID number and an identification token.
- A general explanation section *must* be on the ballot. It can be collapsed.
- For each term on the ballot an explanation *must* be displayable via tooltip.
- Voting *must* include Erststimme and Zweitstimme
- Selection of candidates / parties *must* mutually exclusive (radios).
- An additional radio for invalidation *must* be displayed when the ballot is valid.
- Invalidation of both individually *must* be possible
- An invalid voting *must* be clearly indicated
- When invalid, an explanation *must* be displayed explaining what an invalid ballot means

Backend

Voting

- Every citizen with the right to vote *must* not vote more than once per election, entering valid or invalid Erstimme and Zweitstimme
- Citizens *must* not vote in any other Wahlbezirk than the one they are registered in *x*or by Briefwahl.
- Voting *must* only work for parties and candidates that are nominated in that year / in that Wahlkreis.
- It *should* be possible for votes be inserted into the database via batch loading interface.

Nominations

- Parties *must* not be nominated more than once but only once per year
- Parties *must* not hand in more than one Landesliste per federal state per year
- Candidates *must* not be listed on more than one Landesliste per year
- Candidates *must* not run for more than one Wahlkreis per year
- Parties *must* not support more than one single candidate per Wahlkreis per year

Evaluation

- Evaluation of election results *must* follow the current system (Saint Lague)
- (Preliminary) Results *should* be updated in real time as soon as voting occurs
- Sending updated results to the clients *should* use WebSockets[i]
- A defined interface *could* exists to change the seat distribution method (e.g. from Saint Lague to D'Hondt)

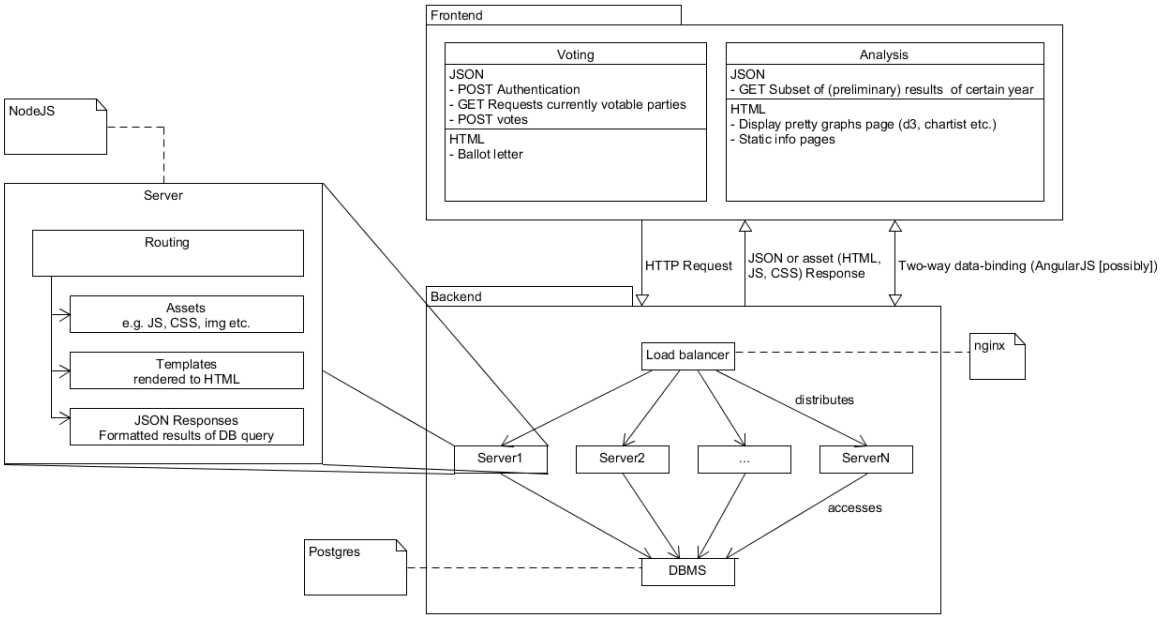
Database

- The Database *will not* be redundant to prevent synchronization overhead.
- Constraints on number of votes and right to vote, Wahlbezirk, number of candidates, party membership, Landeslisten as listed above *must* be implemented on database level (check constraints).
- Error *should* be caught early, automatic recovery is preferred.
- Errors can be propagated, however error messages *must* be easy to understand and easy to recover from.
- Accumulation of results per Wahlkreis and federal state *must* be implemented with views.
- Results *must* be held in views for as long as the election is going on.
- Final results *must* be stored persistently once the election is over and official results have been calculated.
- Seat distribution according to the distribution system *should* be calculated in the database as a view.
- Identification tokens *must* be stored in hashed and salted format. Hashing must occur on the server. A slow hash function is preferred.
- Altering the evaluation system for seat distribution *should* only require the change of a single database query or backend function. Subqueries and sub-function not included.
- Geographic data *should* be stored in the database as well (outlines of state etc.)

Server

- Servers should be redundant behind a load-balancing solution (e.g. nginx[ii])
- Load balancing will not be redundant.
- Serving assets[iii] and answering queries could be separated on dedicated servers.
- Voting *must* require authentification.
- Requesting results / accumulated data will not require authentification.
- Raw data *will not* be accessible
- Data that may offer insight into individual votes (e.g. low number of total votes, low entropy) *must* be withheld.
- A defined and **documented** API for accessing and altering data *must* exist.
- Error responses *must* have meaningful error messages and *must* be documented.
- Results that are unlikely to change (e.g. old election results) *should* be cached.

General System Architecture



Non-functional Requirements

- Privacy
  - Within the database there *must* be no association between citizens and their votes. Within the database no such relation can be derived from other data.
  - Data aggregations that are accessible for user *must* be limited in a way that ensures no information can be inferred for the individual data subsets.
- Reliability and performance
  - The system *must* handle at least **100.000** voting transactions nearly simultaneous
  - The system *must* handle at least **200.000** analysis requests per minute
  - both *must* be handled at the same time
  - Response time for voting transactions *must* be less than **1 second**
  - Response time for analysis requests *must* be less than **3 second**
- Robustness
  - Data *must* be stored in a way that prevents data loss due to hardware or software error
  - Backend systems *must* have automatic failure recovery / restart capabilities.
- Security
  - A secure way of authenticating *must* be required for the user to cast his vote
  - All data *must* transported in a way that prevents unauthorized access.
  - Access to the database and the raw data *must* be restricted.

[i] https://developer.mozilla.org/en-US/docs/Web/API/WebSocket
[ii] https://www.nginx.com
[iii] Assets include static HTML files, JavaScript and CSS