c18n

A Community Discussion Platform

| S. No. | Contributor | Comments | Date | Reviewed By | Review Date |
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| 1 | Jitender Singh | Introduction, Architecture dagram | Jul/25/2021 |  |  |
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# Introduction

The community discussion platform code named **c18n** (naming convention borrowed from other [numeronyms](https://en.wikipedia.org/wiki/Numeronym) like k8s, i18n, l10n etc.) is a community platform to support user discussions and direct messaging between users or user-groups.

The primary goal is provide a social network service where users across the globe can connect to each other, form communities based on their interest areas, create user-group with people they know directly or indirectly and engage in discussions, or send direct messages.

The **c18n** platform intends to build a strong user base by providing them with a rich feature set including (but not limited to) community creation, rich media posts containing text, images, audio, video and other interactive media, user discovery, likes, comments and shares, direct and group messaging, user discussion threads, custom profiles and building of user circles / friends networks.

As the user base is expected to grow to millions of users worldwide, the c18n platform aims to make use of a highly scalable, fault tolerant and low latency architecture by using various streaming and big data solutions.

For the proof of concept app for **c18n**, the focus area will be limited to a system that provides an end to end implementation of the community posts and direct user (or user-group) messaging. We also intend to provide a set of custom scripts to make it easy to generate the required data and a functional UI to visualise the user experience.

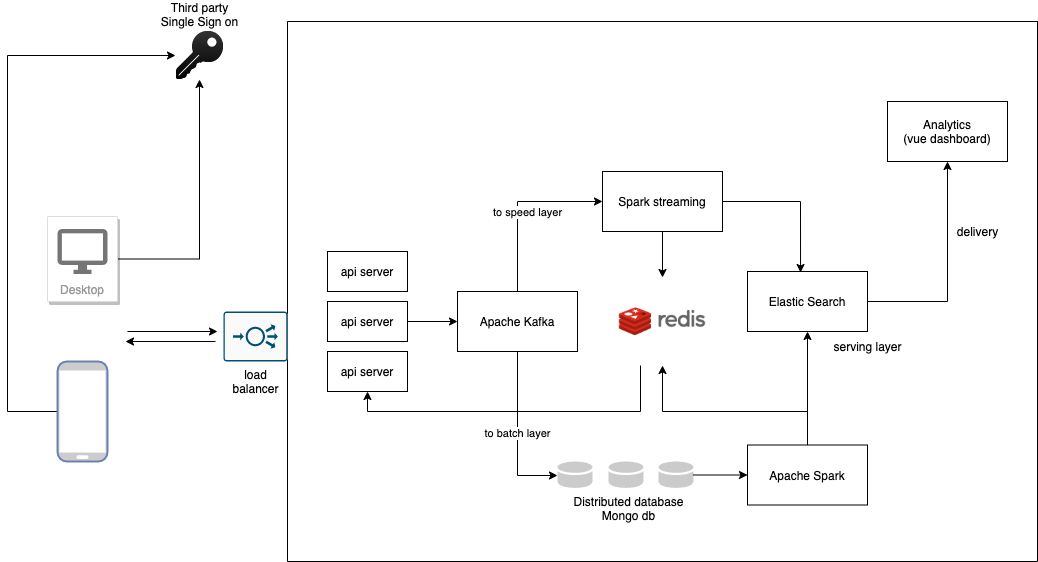
The PoC app is expected to have all the primary components running in their simplest configuration such that the entire **c18n** PoC app can be set up and run on a single node (or a single node cluster.)

# High Level design

Fig. 1 - High Level Design

The figure above shows the proposed high level design diagram for the **c18n** app.

The design diagram primarily caters to the following use cases, and is subjected to changes with the introduction of new requirements / features.

* User registration
* User login
* User discovery
* Community creation
* Community discovery
* Joining a community
* Inviting users to join a community
* Accept / decline an invitation
* User-Group creation
* User-Group discovery
* Joining a user-group
* Inviting users to join a user-group
* Accept / Decline an invitation
* Community post containing
  + text
  + images
  + videos
* Share a community post
* Comment on a community post
* Like a community post
* Direct message to a user
* Reply to a user message
* Message (broadcast) to a user-group
* Comment / Reply on a user-group message
* Like a user-group message
* Reporting / Analytics
* Ad hoc queries

### Api Servers

The application is supposed to have multiple scalable api server components, each of components catering to one particular type of resource and its associated use cases.

The api servers for Users, Communities, User-Groups, Messaging etc will be deployed via kubernetes deployments and each one of the deployments can be scaled up / down independently, depending upon the incoming traffic volume.

We intend to use HTTP based apis for use-cases related to user authentication, creation of user-groups, communities and other non-heavy workflows, while use-cases requiring heavy media flow, longer connections and instant user notifications (e.g. messages, posts, likes, shares) shall be implemented via web-sockets.

The user facing servers shall be further split into application backend servers and frontend servers to make it easy to develop the two independently and separate the presentation layer from the backend apis. The api (backend) server thus will only accept requests from the frontend servers.

We intend to use python/flask for implementing the backend api servers, while the frontend shall be using Vue.js

### Message Queue - Apache Kafka

Apache Kafka shall be used to decouple the user facing servers from the core application components. In practice, some of the low volume apis may (for example community creation, user creation ) may bypass Kafka and directly save the data to a database. This shall simplify the workflows that require events to be processed in specific order (for example, a community must be created first before posting a message to it.)

Further, the components responsible for creating a resource may emit an event like - “a new user has been created”, or “a new community has been created”, enabling the Kafka consumers to pick up and take appropriate action on it (e.g. we may want to build a list of users that may be interested in joining this community, and send them a **suggested community** notification.)

The api (backend) servers shall act as Kafka producers and shall push incoming event streams such as new messages / posts, likes, share to the Kafka server.

### Append only distributed db - Mongo db

We shall make use of a distributed database for storing the event metadata (for example, text content / urls of posts and messages, likes, shares and other information related to creation and subscriptions of various communities, user-groups and their mappings to the users of the c18n platform.

We intend to use an append only database in accordance with the guidelines for implementing the lambda architecture, which shall accept data from Kafka to serve as the batch layer.

For the PoC, we plan to make use of a mongo db server owing to its ease of setup. For a real production case we may want to explore Hadoop hdfs/hbase or Cassandra.

### Batch Layer - Kafka / Custom scripts

TBD - Not yet explored.

For generating the batch views, we may use custom queries triggered via external scripts or through Elastic search, or use a batch processing system like Apache Kafka.

### Distributed File System - S3 / HDFS / GridFS

The media files posted by the users shall be saved into a distributed storage like S3 or Hadoop hdfs.

However, for the PoC, we may use mongo db with GridFS support to save on the cost and effort of setting up a dedicated distributed file storage.

### Speed Layer - Kafka Streams / Spark Streams

We shall be using Spark streams or Kafka stream for the speed layer of the lambda architecture.

This component shall be responsible for generating the speed view and save the view to the serving layer, (to be implemented via Elastic Search)

TBD - Yet to explore both the options and need to figure out which one is more suitable for the PoC.

### Serving Layer - Elastic Search

We plan to use elastic search for combining the speed and batch views and serve the results to both the api servers and in turn the end users, and to the analytics dashboard.

### Cache - Redis

In order to speed up the query and reduce the load on the database, we plan to use a redis cache server. Redis shall be used to hold the recent events data, for example currently logged in user's info, recently created communities, recent posts belonging to large user communities, or recents posts by users having large following.

### RDBMS / Graph databases

A relational database may be used to hold user information, roles and access permissions. As we do not expect the total number of users to cross a few billions, a traditional RDBMS may work fine for this, however if there is a need to build a user - user relationship networks, followers / fans or a friends of friends network, we may want to explore a graph database for such cases.

For the PoC, any information related to dummy users shall be stored in the Mongo db itself.

### Analytics Dashboard

We shall be using ElasticSearch for various reports and other ad-hoc queries. The Python / Flask api servers shall expose api endpoints to the frontend, and use search queries to fetch data from elastic search and serve the same to the frontend app.

The dashboard shall be implemented with Vue.js and accessible to the users having required roles / permissions (e.g. users with **admin** / **analytics** role).

In a production environment, the access to the analytics dashboard may further be restricted by the network / firewall policies, and by allowing access from the corporate VPNs only.

# Design Components

The PoC app intends to use the following components **exposed via the api servers** -

### Users (Registration, Authentication, Authorisation and discovery)

User registration can be done via a hosted user authentication service, which provides a form based interface for new users to supply user information (email / password / phone / username etc) and validate them via email or a secondary channel (eg. Sms / voice call)

In addition to this, c18n platform will also provide the option to use a third party authentication, so that users can use their existing accounts (Google / Facebook / okta etc) to join the c18n platform.

Once signed up and validated via email / phone, the users can authenticate themselves to the c18n platform and start accessing its services. Both the hosted and third party auth services will make use of JWT token to validate the authenticity of the users. The token may have an expiry period set to 7 days by default, and may need to re-login once the JWT token is expired.

All the users will be given a default **regular user** role. In future, the c18n platform may also support additional roles (say, **premium users**, **api** **developers** etc).

In addition to the above, there will be one of more users assigned with **administrator** roles, having access to various subsystems (e.g. analytics dashboard) and control permissions (user or content deletion/deactivation etc). A separate authorisation table shall be used to decide the user roles and permissions.

For the **c18n** PoC app, we are going to make use of okta third party authentication for signing up new users. In addition to this, the PoC app will also allow batch creation of dummy users via a user creation api.

For the PoC app, users signing up via okta are going to be treated as admin users and will have the permissions to use the analytics dashboard, batch create dummy users or impersonate other users.

In addition to this, a user discover api will allow users to search other users by name and any other public info.

### Communities

The communities module will handle use cases related to creation, discovery and user mappings to a community.

Future scope of this module may also include features like assigning tags to communities and extend the community discovery / search by associated tags. Further, we may introduce the concept of transferring the community ownership to other users, providing one or more users with a moderator role and management of various community specific workflows (e.g. limiting the number of posts per user, block / kick out certain users, moderation of posts etc.)

# Apis, Schema and Data Flow

All the above listed component for the **c18n** platform are expected to use REST guidelines to implement their apis. We will use json as the primary format for data exchange between the different components as well as to/from end users.

The apis will use the format /api/<version>/<resource-pluralized-name>/[action if any]

Following the standard REST guidelines, we will be using POST requests for resource creation, PUT / PATCH requests for resource update, GET for retrieval, while DELETE shall be used for soft-deletion or deactivating a resource. (Related, see Security Concerns and Guidelines section.)

Below listed table present the various apis associated to the modules listed earlier, along with their sample request / response formats -

### Users APIS

|  | Create a new user |
| --- | --- |
| Request | POST /api/v1/users/new  Accept: application/json, text/plain, \*/\*  Accept-Encoding: gzip, deflate, br  Connection: keep-alive  Host: api-server:80  User-Agent: browser UA  Content-Type: application/x-www-form-urlencoded  Content-Length: 76  username=<username>&email=<[username@domain.com](mailto:username@domain.com)>&password=<password> |
| Response | HTTP/1.0 200 OK  Content-Type: application/json  Content-Length: 397  server: API Web Server  Date: Sun, 25 Jul 2021 11:21:25 GMT  Location: /api/v1/users/<user-resource-id>  {  "\_id": "user-resource-id",  "email": “username@domain.com",  "exp": 1627797085.108836,  "iat": 1627192285.108832,  "name": "username",  "sub": "user-jwt-token",  "token": "user-jwt-token,  "ver": 1  } |
| Comments | In the PoC app we will be using the above api for creating dummy users in the system, the post request here would require okta validated JWT token to ensure the admin privileges. |
| Data Flow | Front End / User App -> Users api server |

|  | Retrieve a user |
| --- | --- |
| Request | GET /api/v1/users/  or  GET /api/v1/users/<user-resource-id>  Accept: application/json, text/plain, \*/\*  Accept-Encoding: gzip, deflate, br  Connection: keep-alive  Host: api-server:80  User-Agent: browser UA  Content-Length: 0 |
| Response | HTTP/1.0 200 OK  Content-Type: application/json  Content-Length: 397  server: API Web Server  Date: Sun, 25 Jul 2021 11:21:25 GMT  Location: /api/v1/users/<user-resource-id>  {  "\_id": "user-resource-id",  "email": “username@domain.com",  "exp": 1627797085.108836,  "iat": 1627192285.108832,  "name": "username",  "sub": "user-jwt-token",  "token": "user-jwt-token,  "ver": 1  } |
| Comments | The first api may be accessible to regular users to fetch their own profile information, the second format can be made available to admin users to obtain info on any of the platform’s users. |
| Data Flow | Front End / User App -> Users api server |

|  | Update a user |
| --- | --- |
| Request | PATCH /api/v1/users/<user-resource-id>  Accept: application/json, text/plain, \*/\*  Accept-Encoding: gzip, deflate, br  Connection: keep-alive  Host: api-server:80  User-Agent: browser UA  Content-Length: 123  {  "name": “new-user-name",  } |
| Response | HTTP/1.0 200 OK  Content-Type: application/json  Content-Length: 397  server: API Web Server  Date: Sun, 25 Jul 2021 11:21:25 GMT  Location: /api/v1/users/<user-resource-id>  {  "\_id": "user-resource-id",  "email": “username@domain.com",  "exp": 1627797085.108836,  "iat": 1627192285.108832,  "name": “new-user-name“,  "sub": "user-jwt-token",  "token": "user-jwt-token,  "ver": 1  } |
| Comments | Api may allow only specific fields (e.g. name, display-name, location etc) to be updated. |
| Data Flow | Front End / User App -> Users api server |

|  | Search user(s) |
| --- | --- |
| Request | GET /api/v1/users/search?name=foo&location=bar  Accept: application/json, text/plain, \*/\*  Accept-Encoding: gzip, deflate, br  Connection: keep-alive  Host: api-server:80  User-Agent: browser UA  Content-Length: 0 |
| Response | HTTP/1.0 200 OK  Content-Type: application/json  Content-Length: 397  server: API Web Server  Date: Sun, 25 Jul 2021 11:21:25 GMT  [{  "\_id": “user-resource-id",  "name": “user-name“,  "location": “http://api-server/api/v1/users/<user-resource-id>“,  },  {  "\_id": "user2-resource-id",  "name": “user2-name“,  "location": “<http://api-server/api/v1/users>/<user2-resource-id>“,  },  …  ] |
| Comments | All the GET apis that are expected to return more than 1 resources must be paginated.  Related - see Security Concerns and guidelines. |
| Data Flow | Front End / User App -> Users api server |

### Communities APIs

|  | Create a new community |
| --- | --- |
| Request | POST /api/v1/communities/new  Accept: application/json, text/plain, \*/\*  Accept-Encoding: gzip, deflate, br  Connection: keep-alive  Host: api-server:80  User-Agent: browser UA  Content-Type: application/x-www-form-urlencoded  Content-Length: 76  name=<community-name>&description=<community-description>&tags=<csv list of tags> |
| Response | HTTP/1.0 200 OK  Content-Type: application/json  Content-Length: 397  server: API Web Server  Date: Sun, 25 Jul 2021 11:21:25 GMT  Location: /api/v1/communities/<coommunity-resource-id>  {  "\_id": "community-resource-id",  “name": “community-name“,  "description": “community-description“,  “created\_on": 1627797085,  “created\_by": “user-resource-id”,  “tags”: “list of tags”,  "users": “[http://api-server/api/v1/communities/<community-resource-id>/users](http://api-server/api/v1/communities/%3Ccommunity-resource-id%3E/users)”,  “posts": [http://api-server/api/v1/communities/<community-resource-id>](http://api-server/api/v1/communities/%3Ccommunity-resource-id%3E)/posts",  } |
| Comments | The api shall create a new community with a given name / description / tags, and return its metadata. It shall also return links to fetch users list and recent posts (both of which shall return empty set initially) |
| Data Flow | Front End / User App -> Communities api server |

|  | Retrieve a community |
| --- | --- |
| Request | GET /api/v1/communities/<community-resource-id>  Accept: application/json, text/plain, \*/\*  Accept-Encoding: gzip, deflate, br  Connection: keep-alive  Host: api-server:80  User-Agent: browser UA |
| Response | HTTP/1.0 200 OK  Content-Type: application/json  Content-Length: 397  server: API Web Server  Date: Sun, 25 Jul 2021 11:21:25 GMT  Location: /api/v1/communities/<community-resource-id>  {  "\_id": "community-resource-id",  “name": “community-name“,  "description": “community-description“,  “created\_on": 1627797085,  “created\_by": “user-resource-id”,  “tags”: “list of tags”,  "users": “http://api-server/api/v1/communities/<community-resource-id>/users”,  “posts": [http://api-server/api/v1/communities/<community-resource-id>](http://api-server/api/v1/communities/%3Ccommunity-resource-id%3E)/posts",  } |
| Comments | The api shall retrieve the community object given its resource id. Communities object shall also include links to fetch users and recent posts for the given community. |
| Data Flow | Front End / User App -> Communities api server |

|  | Update a community info |
| --- | --- |
| Request | PUT/PATCH /api/v1/communities/<community-resource-id>  Accept: application/json, text/plain, \*/\*  Accept-Encoding: gzip, deflate, br  Connection: keep-alive  Host: api-server:80  User-Agent: browser UA  Content-Length: 123  {  "name": “new-community-name”,  "description": “new-community-description”,  "tags": “csv list of tags”,  } |
| Response | HTTP/1.0 200 OK  Content-Type: application/json  Content-Length: 397  server: API Web Server  Date: Sun, 25 Jul 2021 11:21:25 GMT  Location: /api/v1/communities/<community-resource-id>  {  "\_id": "community-resource-id",  “name": “new-community-name“,  "description": “new-community-description“,  “created\_on": 1627797085,  “tags”: “list of tags”,  “created\_by": “user-resource-id”,  "users": “[http://api-server/api/v1/communities/<community-resource-id>/users](http://api-server/api/v1/communities/%3Ccommunity-resource-id%3E/users)”,  “posts": [http://api-server/api/v1/communities/<community-resource-id>](http://api-server/api/v1/communities/%3Ccommunity-resource-id%3E)/posts",  } |
| Comments |  |
| Data Flow | Front End / User App -> Communities api server |

|  | Invite a user to a community |
| --- | --- |
| Request | POST /api/v1/communities/<community-resource-id>/users/<user-resource-id>/invite  Accept: application/json, text/plain, \*/\*  Accept-Encoding: gzip, deflate, br  Connection: keep-alive  Host: api-server:80  User-Agent: browser UA  Content-Length: 0 |
| Response | HTTP/1.0 200 OK  Content-Type: application/json  Content-Length: 397  server: API Web Server  Date: Sun, 25 Jul 2021 11:21:25 GMT  Location: /api/v1/communities/<community-resource-id>/users/<user-resource-id>/invite  {  "\_id": “invite-resource-id",  "status": “default-invite-status”,  "created\_on": 1627797085,  } |
| Comments | The api create an invite for the given user id to a community id, and returns a location where the inviter can check the status of the invite. A successful call to this api shall emit an event to Kafka suggesting a new user invite has been generated, the consumer for the event shall send a notification to the target user.  The originator of the invite may use the user search api to obtain list of users he/she may want to invite to a community. |
| Data Flow | Front End / User App -> Communities api server |

|  | Accept an invite |
| --- | --- |
| Request | PUT /api/v1/communities/<community-resource-id>/invite/<invite-resource-id>/accept  Accept: application/json, text/plain, \*/\*  Accept-Encoding: gzip, deflate, br  Connection: keep-alive  Host: api-server:80  User-Agent: browser UA  Content-Length: 0 |
| Response | HTTP/1.0 200 OK  Content-Type: application/json  Content-Length: 397  server: API Web Server  Date: Sun, 25 Jul 2021 11:21:25 GMT  Location: /api/v1/communities/<community-resource-id>  {  "\_id": "community-resource-id",  “name": “community-name“,  "description": “community-description“,  “created\_on": 1627797085,  “created\_by": “user-resource-id”,  “tags”: “list of tags”,  "users": “[http://api-server/api/v1/communities/<community-resource-id>/users](http://api-server/api/v1/communities/%3Ccommunity-resource-id%3E/users)”,  “posts": [http://api-server/api/v1/communities/<community-resource-id>](http://api-server/api/v1/communities/%3Ccommunity-resource-id%3E)/posts",  } |
| Comments | The api is originated by the recipient of an invite, accepting the invite shall add the user to the named community. Accepting an invite should take the user to the community page. The community object returned by the api should then show a list of recent posts.  This api shall also trigger an event to Kafka, the consumers may want to delete / update the invite status. |
| Data Flow | Front End / User App -> Communities api server |

|  | Decline an invite |
| --- | --- |
| Request | PUT /api/v1/communities/<community-resource-id>/invite/<invite-resource-id>/decline  Accept: application/json, text/plain, \*/\*  Accept-Encoding: gzip, deflate, br  Connection: keep-alive  Host: api-server:80  User-Agent: browser UA  Content-Length: 0 |
| Response | HTTP/1.0 200 OK  Content-Type: application/json  Content-Length: 2  server: API Web Server  Date: Sun, 25 Jul 2021 11:21:25 GMT  {} |
| Comments | The api is originated by the recipient of an invite, declining the invite shall trigger an event to Kafka, the consumers may want to delete / update the invite status. |
| Data Flow | Front End / User App -> Communities api server |

|  | Subscribe to a community |
| --- | --- |
| Request | PUT /api/v1/communities/<community-resource-id>/subscribe  Accept: application/json, text/plain, \*/\*  Accept-Encoding: gzip, deflate, br  Connection: keep-alive  Host: api-server:80  User-Agent: browser UA  Content-Length: 0 |
| Response | HTTP/1.0 200 OK  Content-Type: application/json  Content-Length: 397  server: API Web Server  Date: Sun, 25 Jul 2021 11:21:25 GMT  Location: /api/v1/communities/<community-resource-id>  {  "\_id": "community-resource-id",  “name": “community-name“,  "description": “community-description“,  “created\_on": 1627797085,  “created\_by": “user-resource-id”,  “tags”: “list of tags”,  "users": “[http://api-server/api/v1/communities/<community-resource-id>/users](http://api-server/api/v1/communities/%3Ccommunity-resource-id%3E/users)”,  “posts": [http://api-server/api/v1/communities/<community-resource-id>](http://api-server/api/v1/communities/%3Ccommunity-resource-id%3E)/posts",  } |
| Comments | A user may want to join a community (without an invite). The api shall add the current user to the members of community and emit an event to Kafka. |
| Data Flow | Front End / User App -> Communities api server |

|  | Unsubscribe a community |
| --- | --- |
| Request | PUT /api/v1/communities/<community-resource-id>/unsubscribe  Accept: application/json, text/plain, \*/\*  Accept-Encoding: gzip, deflate, br  Connection: keep-alive  Host: api-server:80  User-Agent: browser UA  Content-Length: 0 |
| Response | HTTP/1.0 200 OK  Content-Type: application/json  Content-Length: 2  server: API Web Server  Date: Sun, 25 Jul 2021 11:21:25 GMT  {} |
| Comments | A user may want to leave a community. The api shall remove the current user from the list of community member and emit an event to Kafka. |
| Data Flow | Front End / User App -> Communities api server |

|  | Search for communities |
| --- | --- |
| Request | GET /api/v1/communities/search?q=<search-str>&tags=<csv list of tags>  Accept: application/json, text/plain, \*/\*  Accept-Encoding: gzip, deflate, br  Connection: keep-alive  Host: api-server:80  User-Agent: browser UA |
| Response | HTTP/1.0 200 OK  Content-Type: application/json  Content-Length: 1234  server: API Web Server  Date: Sun, 25 Jul 2021 11:21:25 GMT  [{  "\_id": "community-resource-id",  “name": “community-name“,  "description": “community-description“,  “created\_on": 1627797085,  “created\_by": “user-resource-id”,  “tags”: “list of tags”,  "users": “[http://api-server/api/v1/communities/<community-resource-id>/users](http://api-server/api/v1/communities/%3Ccommunity-resource-id%3E/users)”,  “posts": [http://api-server/api/v1/communities/<community-resource-id>](http://api-server/api/v1/communities/%3Ccommunity-resource-id%3E)/posts",  },  {  "\_id": "community2-resource-id",  “name": “community2-name“,  "description": “community2-description“,  “created\_on": 1627798196,  “created\_by": “user2-resource-id”,  “tags”: “list of tags”,  "users": “[http://api-server/api/v1/communities/<community2-resource-id>/users](http://api-server/api/v1/communities/%3Ccommunity-resource-id%3E/users)”,  “posts": [http://api-server/api/v1/communities/<community2-resource-id>](http://api-server/api/v1/communities/%3Ccommunity-resource-id%3E)/posts",  }  …  ] |
| Comments | The api shall return a list of communities having name / description matching the given string or communities having one or more of given tags. The answer records shall be sorted by most relevance first. |
| Data Flow | Front End / User App -> Communities api server |

# Design choices / improvements

Several design choices are currently influenced by our lack of experience / exposure to some of the streaming / big data technologies, as well as the time constraints for implementing the PoC application.

A thorough review and exploration of the other alternatives may lead to a better suited design for the community discussion application.

Apart from this, many other components may be better implemented with commercial applications, that are not accessible to us due to licensing and monetary requirements, and thus leaving us with the open-source solutions only.

# Security concerns / guidelines

* Under no circumstances shall the data be deleted from the system and maximum efforts shall be made to preserve the history of every resource creation, update and access, except where the data policies (e.g. GDPR) or law-enforcement require the data to be deleted upon expiry or upon user request.
* All the GET apis that are expected to return more than 1 resources (e.g. search users, search communities etc) must have pagination support. The apis may support a configurable default value (say 10 records per query), while a non-configurable / hardcoded max value must restrict the number of items per search queries to an allowed maximum (say max 100 records per query).
* The backend api servers should accept connection only from the frontend servers, and must mandate csrf headers.
* All the http apis must support and validate the user JWT tokens, and do proper authorisation checks before allowing access to any resources, except for the apis which may be open for access without authentication (for example, search apis)

# Future Scope

Several other feature may be required for the application in order for it to serve to a global platform, including but not limited to -

Content suggestion

Content rating / popularity scores

Integration with other sites, link embedding

Support for user content in various languages.

Translation of non-native language content to a user’s native language.

Support for newer media formats like interactive 3-d videos and images.

Copyright infringement detection, copyright claims workflows and strike down policies.

User reputation system

User-driven reporting and flagging of malicious and offensive content, also automated detection of such content.

Throttling, DDoS prevention and prevention of other attack vectors like XSS

Search Engine optimisation.

Monetisation workflows.

Developer apis

Usability and UI / UX improvements

Support for various platforms, mobile applications

Reducing network latency, CDNs, geo load balancing, DNS servers.