



# NEXT GENERATION SOCIAL NETWORK ARCHITECTURE

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## ABSTRACT

*This research focuses on the architectural aspects of social networks that comprises of identification of gray areas, analysis of social networks and forecasting of shortcomings in order to suggest a better architectural model for the development. This research focuses on case study issues and challenges and to counterpart them with appropriate solution through comparative analysis and to come across with a flexible architecture model that supports high scalability, availability and performance at very cheap rate. Moreover researcher mainly focused on the software aspects of architecture which includes databases and programing languages supported by comparative analysis, research, surveys and some percentage of experiments. Research taken place at multiple levels and domains such as Semantics, Real-Time Application, Service Oriented Architecture and Unstructured, Structured and Semi-structured data storage systems, while discussing various issues and challenges with their possible solutions.*

**Key Words:** Social Network, Architecture, Real-time Application, New Application Domains, Service Oriented Architecture, Web Of Data, Linked Data, Semantic web, NOSQL, Unstructured Data

**INSPEC Classification :** A9555L, A9630, B5270

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\* The material presented by the author does not necessarily portray the viewpoint of the editors and the management of the Institute of Business & Technology (IBT)

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## 1. INTRODUCTION

With more than half of the world's population already living in cities or neighborhoods, and with the urban population projected to grow by more than one billion people between 2015 and 2030, the race is on to improve our cities and neighborhoods. Improving services while cutting costs and saving time became a major factor to provide services that ensure the best life quality for every citizen. Authorities like municipalities are responsible to lead the improvement revolution for all type of services by using any possible tools to reach the target of successful System. Since the creativity always starts with individuals; we made a general study about the Municipality of our area Alhasa, we investigate the problems with difficulties and came out with creative solution which can improve the Municipality services. Once you need to report Inquiry about any issue, you will face several difficulties. First difficulty is the location of Alhasa Municipality which is built in the heart of HOFUF crowded city and that makes it almost unreachable at rush hours. Second, it is hard to find the concern person who can receive your observation notification and take action , then if someone decide to call the Municipality he\she have to wait very long time before getting the usually negative answer which redirect to another phone number .

Social Networking Websites are the platform through which people connects to each other to form social relations or social networks through interest, real life connection, backgrounds, similarities and activities. Social network services include e-mail and instant messaging service to interact with connections. The best definition of the Social Network Sites as a website service that allow it users to share their profile privately, publicly or semi publicly to other users of the networks, to show the list of users that individual is connected to others in a system and to view and transverse the connection between themselves and connection of connections in a system [1][2]. What makes Social Network Site unique is not that it provides an individual to connect with strangers but also enable user to make their social network visible. Social Networks Sites are gaining more popularity these days. Large amount of Internet users are now migrating to social networks, which has opened up a new application domains. Popularity of social networks also bought many challenges and consideration for the developers. If we could analyze existing social networks and consider up-comings, we could able to suggest a better architectural model [3][4].

Initially many of the famous Social Network Sites are targeted to particular groups and then expanded themselves at international level and for everyone. This is the main reason that many of the Social Network Sites were not designed to be big, incoming traffic from users made them to expand their networks, which cost them heavy in terms of money, scalability and performance. Also there are some upcoming challenges that many Social Networks will experience, one of them is transition of Web 2 .0 to Web 3.0. Author has mitigated these challenges and suggested an architecture that will provide platform to develop Next Generation Social Network Sites [5][6][7].

## 2. DISCUSSION AND ANALYSIS OF RELATED WORK

### 2.1 On Social Network Web Sites: Definition, Features, Architectures and Analysis Tools

In above mention paper authors (Vala Ali Rohani and Ow Siew Hock) have defined

social networks, features, Architecture. This paper related to my research since it discusses architecture at some instinct, since paper is too old therefore does not discuss latest development in the field of social networks. Furthermore it does not give insight of Social Networks Architecture and explains things at surface level [8][9][10].

### 2.2 New Generation of Social Networks Based on Semantic Web Technologies: the Importance of Social Data Portability

In above mention research authors (Liana Razmerita, Martynas Jusevicius, Rokas Firantas) highlighted an issue that social data portability and suggested that it can be addressed at an architecture level by making social network on semantic web, application with FOAF, SIOC and Linked Data Technologies, they designed prototype on open source social network project based on java also showed how semantic web can utilize data from Freebase and DBpedia [11][12].

## 3. EXPERIMENTAL SETUP

For experimental setup author have surveyed through questionnaires and on the behalf of it author have constructively formed analysis and major requirements of the system. This survey specifically taken from software development back ground interviewers; majority of them are Software Analyst. The sample size of the survey was 19, since this interview is being taken in close environment on Internet therefore it only consist of people with computer back grounds and with good domain knowledge at architectural level, majority of interviewers are from different organization. Since the questionnaire covers a large domain therefore author have also explained various things within questions details including assumptions regarding social network architecture [13][14].

### 3.1 General Questions

These questions are being taking for general assumption of the interviewers' background, to form a general understanding of the interviewers regarding topic and sense of awareness that interviewers have in research [15][16].

Interviewers by Profession:

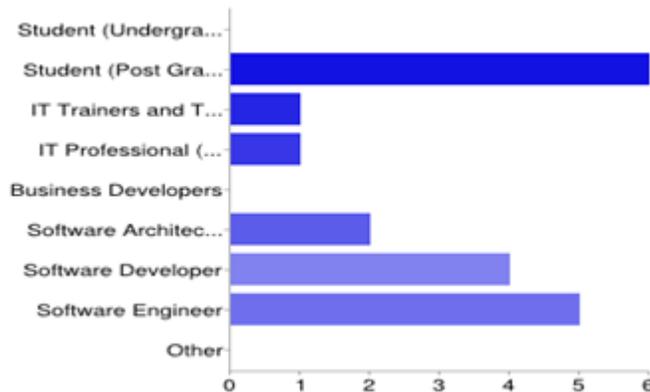


Figure 1 :Audience

Student (Under graduation)	0	0%
Student (Post Graduation or High)	6	32%
IT Trainers and Teachers	1	5%
IT Professional (Manager, Chairman, Director etc.)	1	5%

Business Developers	0	0%
Software Architect and Analyst	2	11%
Software Developer	4	21%
Software Engineer	5	26%
Other	0	0%

**How much technical knowledge do you have regarding Web Technologies?**

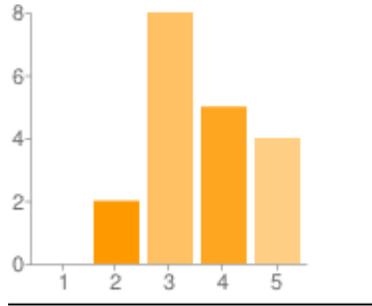


Figure 2: Technical Knowledge of Web Technology

1 - None	0	0%
2 - Basic	2	11%
3 - Average	8	42%
4 - Above Average	5	26%
5 - Excellent	4	21%

**How much understanding do you have regarding Semantic Web?**

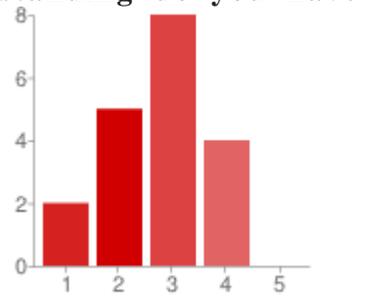


Figure 3: Understanding related Semantic Web

1 - None	2	11%
2 - Basic	5	26%
3 - Average	8	42%
4 - Above Average	4	21%
5 - Excellent	0	0%

### How much understanding do you have regarding Cloud Computing?

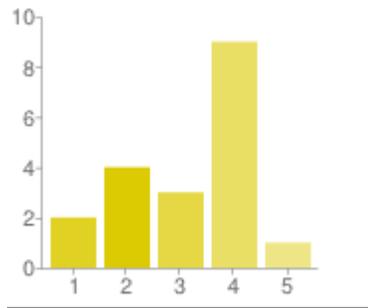


Figure 4: Understanding related to Cloud Computing

1 - None	2	11%
2 - Basic	4	21%
3 - Average	3	16%
4 - Above Average	9	47%
5 - Excellent	1	5%

### How much understanding do you have regarding NoSQL (Non-Relational) Databases?

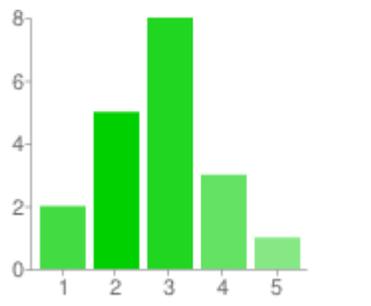


Figure 5: Understanding related to NoSQL

1 - None	2	11%
2 - Basic	5	26%
3 - Average	8	42%
4 - Above Average	3	16%
5 - Excellent	1	5%

### How much understanding do you have regarding Real Time Web Application?

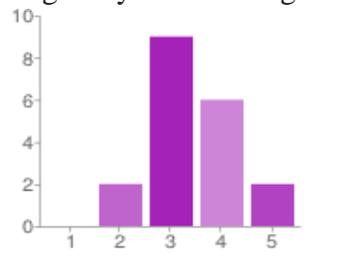


Figure 6: Knowledge related to Real time Web technology

1 - None	0	0%
2 - Basic	2	11%
3 - Average	9	47%
4 – Above Average	6	32%
5 - Excellent	2	11%

How much understanding do you have regarding Rich Internet Application (RIA)?

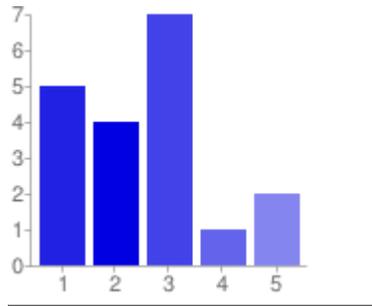


Figure 7: Understanding related to rich internet application

1 - None	5	26%
2 - Basic	4	21%
3 - Average	7	37%
4 – Above Average	1	5%
5 - Excellent	2	11%

How much understanding do you have regarding HTML5 new features?

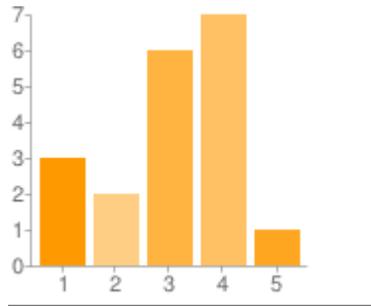


Figure 8: understanding related to HTML5

1 - None	3	16%
2 - Basic	2	11%
3 - Average	6	32%
4 – Above Average	7	37%
5 - Excellent	1	5%

Do you think Real Time Application Web Technologies are required for the development

of Social Networks?

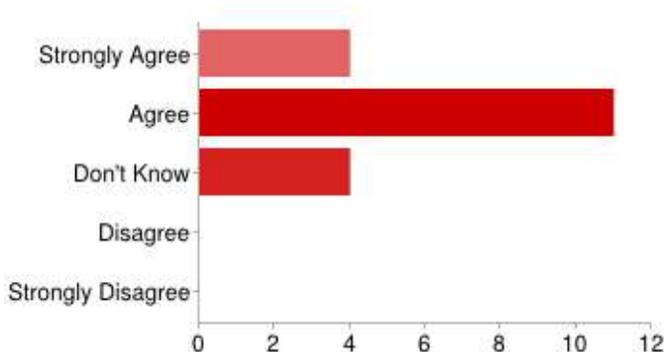


Figure 9 : Statistical Results

Strongly Agree	4	21%
Agree	11	58%
Don't Know	4	21%
Disagree	0	0%
Strongly Disagree	0	0%

What Technologies do you prefer for the development of Social Networks?

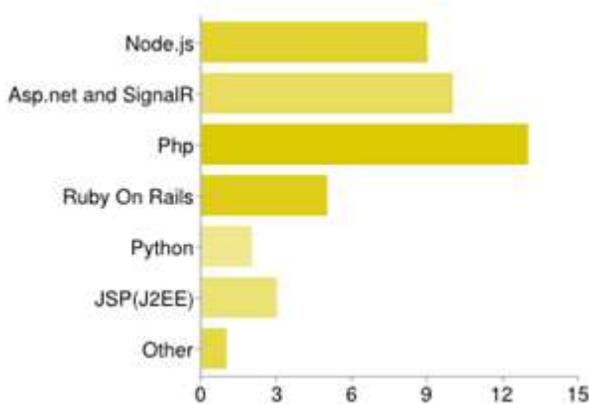


Figure 10: Statistical Results

Node.js	9	47%
Asp.net and Signal R	10	53%
Php	13	68%
Ruby On Rails	5	26%
Python	2	11%
JSP(J2EE)	3	16%
Other	1	5%

What do you think databases should be considered for Social Networks?

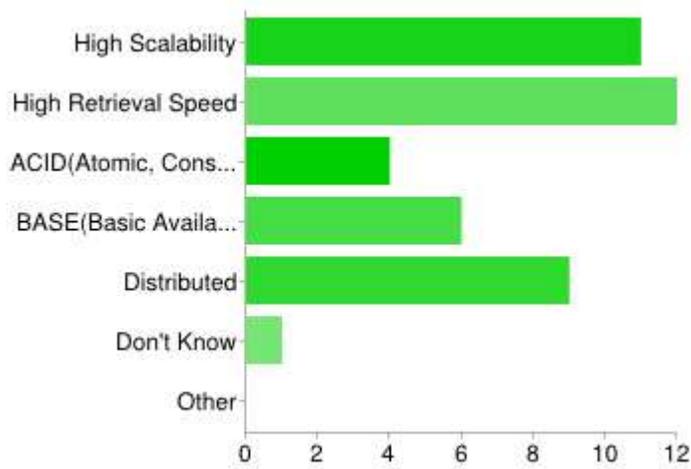


Figure 11: Statistical Results

High Scalability	11	58%
High Retrieval Speed	12	63%
ACID(Atomic, Consistent, Isolated, Durable)	4	21%
BASE (Basic Availability, Soft-State, Eventually Consistent)	6	32%
Distributed	9	47%
Don't Know	1	5%
Other	0	0%

Do you think NoSQL Database is required for the development of Social Networks?

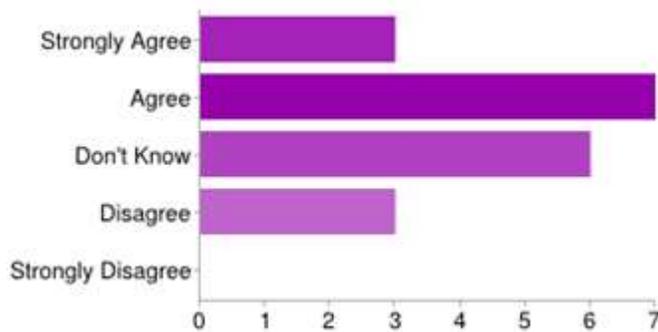


Figure 12: Statistical Results

Strongly Agree	3	16%
Agree	7	37%
Don't Know	6	32%
Disagree	3	16%
Strongly Disagree	0	0%

Do you think In Memory databases are required for caching data (static and dynamic) in Social Networks?

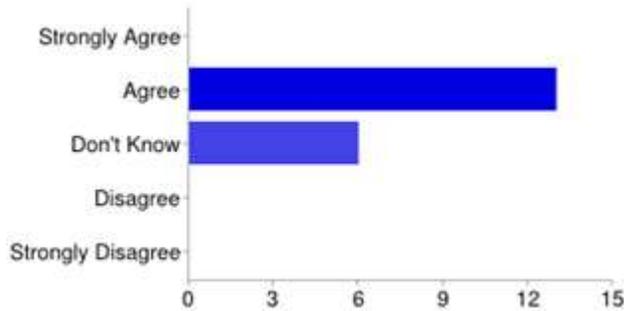


Figure 13: Statistical Results

Strongly Agree	0	0%
Agree	13	68%
Don't Know	6	32%
Disagree	0	0%
Strongly Disagree	0	0%

What databases should be used for caching data of Social Networks?

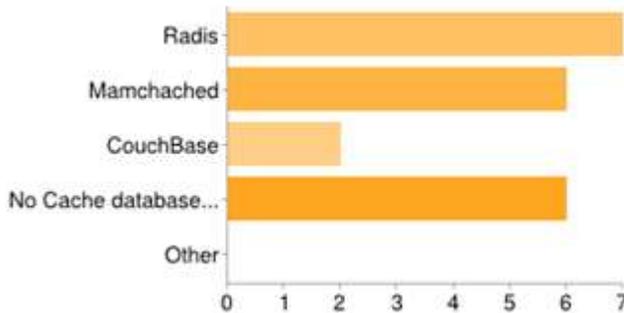


Figure 14: Statistical Results

Redis	7	37%
Memcached	6	32%
Couch Base	2	11%
No Cache database Required	6	32%
Other	0	0%

Do you think NoSQL Graph Databases are good alternative of RDBMS in Social Networks?

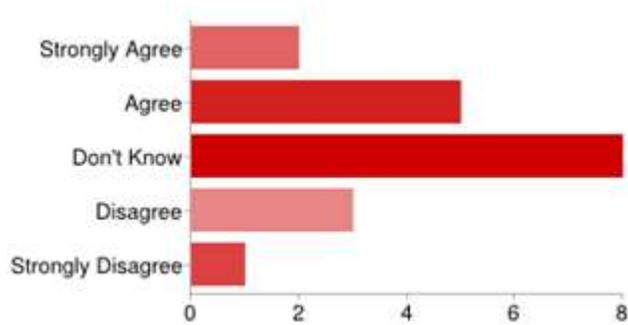


Figure 15: Statistical Results

Strongly Agree                    2        11%  
 Agree                                5        26%  
 Don't Know                        8        42%  
 Disagree                            3        16%  
 Strongly Disagree                1        5%

Do you think Graph Databases are good for enabling graph search with in Social Networks?

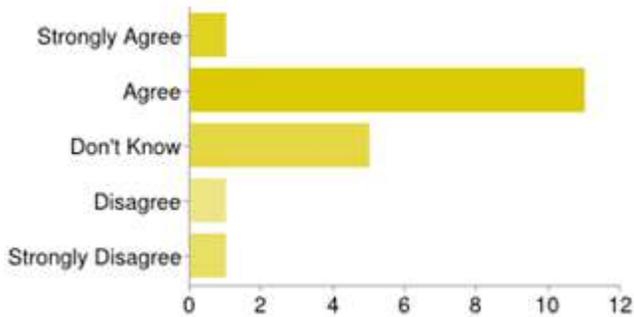


Figure 16: Statistical Results

Strongly Agree                    1        5%  
 Agree                                11      58%  
 Don't Know                        5        26%  
 Disagree                            1        5%  
 Strongly Disagree                1        5%

Do you think Social Networks should have semantics features?

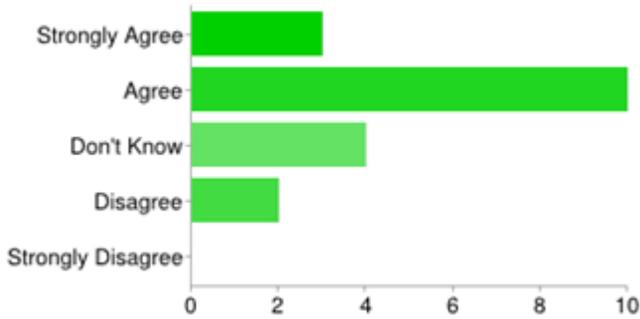


Figure 17: Statistical Results

Strongly Agree	3	16%
Agree	10	53%
Don't Know	4	21%
Disagree	2	11%
Strongly Disagree	0	0%

What databases should be used for storing Unstructured and semi-structured data Social Networks?

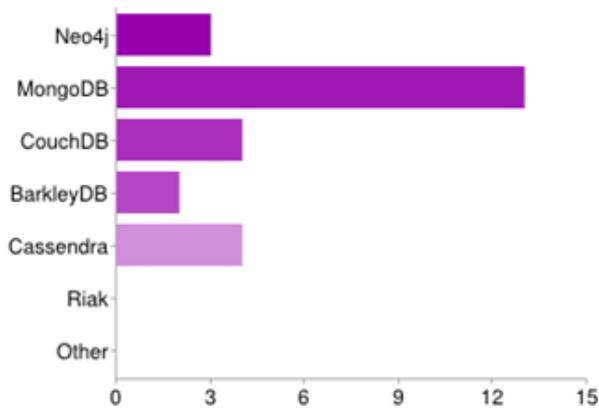


Figure 18: Statistical Results

Neo4j	3	16%
MongoDB	13	68%
CouchDB	4	21%
BarkleyDB	2	11%
Cassandra	4	21%

Riak	0	0%
Other	0	0%

## 4. PROPOSED SOLUTION

For proposing solution author have divided his research into different parts. First part based on the analysis of the Social Networks and its Architecture, Second part of the research is based on identification of the major short-comings that social networks will experience in upcoming years, while third part based on the study of framework and programming language for the next generation social networks, fourth part deals with the storage systems concerns, and last part is the formation of an architecture model for the Next Generation Social Networks summarizing the overall research.

### 4.1 Analysis of existing Social Network Sites

#### 4.1.1 General Features

There are thousands of the Social Network Sites, and each Social Network Site has their own unique features, functions, layouts and details. This section discusses overall features that most of the social networks provides today.

#### 4.1.2 Personal Profile

Most of the social network sites provide users to create and manage their info that appears to others a home page. Although there are sites that provide privacy option for user so that user can decide what to show to friends and what to show to everyone else.

#### 4.1.3 Communication to Other Online Contacts

Various social networks provides a communication channel for its users to communicate to each other's with in social network and as well as outside of social networks. There are numerous ways of communicating with connections. Some of these are instant messaging service, emails, text messaging, through bulletin boards, and even VoIP. Facebook and MySpace is one other prime example of VoIP base communication that uses service, such as Skype. Social network sites also use these communication channels to notify, update or to prompt messages to users about their profile. Twitter also provide users to send messages in form of bulletin to send message to friends about the work they are doing, similarly face book use bulletin board that they call is "Wall" which user uses to send message to their friends in connection.

#### 4.1.4 Personal Bill boards

There are many social networks that provide each of its members to share data on their profile, data such as pictures, videos, contents, blogs, music contents etc., with others. Primarily Twitter, Facebook and YouTube are one of its examples.

#### 4.1.5 Friendship Network

Most of the social network sites provide communication facilities to online connections (i-e friends) through instant messaging, bulletin boards, text messaging and even with VoIP. There is also an option to invite friends and to make and develop friendship list this motivates users to check their profiles regularly.

Graph is mathematical representation of the relationships between the things. A graph is based on the nodes (things, objects) and edges (relationships). It is mathematical tool to model the relation between natural and artificial things economy, power grid, decesses which is widely used by sociologist and anthropologists. Beside of it social networks and graph analysis are the vital tools to study human behavior and web users. It's an obvious that social network analysis can be Social Graph, users of social networks forms graph with their friends, but there are certain issues in formation of and identification of a network connections based on real world knowledge (coworkers, colleagues, school friends etc.)

Now a day's social networking sites provides an option of tag information, which is being used by its users to form, manage and track relation, there are certain terminology use by different social networks for tag, for e.g. Likes, Digg, tweets. Similarly Face book provides Open Graphs interface to interconnect external web pages with Facebook. This can be done by providing a small like button under the media when it click by user it forms connection to that user's profile and information being shared through likes.

Social Network Sites like Facebook and LinkedIn are also providing graph search option through which user can search a publicly accessible info, such as people, pages, photos, friends of friends, school, company, common interest people etc., though relations.

## **4.2 Identity Algorithm and APIs**

Most of the famous social network sites provide an API/ Identity algorithm for identification that is being use widely to third party site. Social Network Sites provides services to its user to share their info to other third party sites. There are mainly 2 types of such API that are majorly being use.

### **4.2.1 Auth**

OAuth provides a user to access server resources on the behalf its owner. It also provides its ends users to authorize third party sites without providing credentials (i-e, Username and password). Facebook also uses OAuth for the authentication and authorization of desktop and mobile App.

### **4.2.2 Open ID**

OpenID is another API that gives its users to an easy sign-in and sign-up functionality. Most of the widely known websites and SNS use OpenID to provide single sign in functionality to its user. MySpace, Flickr, Google, wordpress, Yahoo, Facebook encourages their users to sign up for the account without filling the registration form.

### **4.2.3 Geo-location**

Now days there are some Social Networks that provides user to share their location information through GPS, email, Bluetooth or text messaging. Members of these sites can also comments about places, find friends from nearby location or even places near to their office or allow others to know where they are heading.

### **4.2.4 Mobility**

There are several mobile only Social Networks, with very unique features from one

another which is potentially attractive to its users. But the main and common features that every mobile service social networks have are that they detect physical presence of the user and exchanges information.

#### **4.2.5 Social Gaming**

There are many Social Networks that provides open distribution of social gaming through their platforms, (Facebook and MySpace etc.). Some of the major social gaming distributors are Zynga and PlayFish.

#### **4.2.6 Social Television**

There are numerous of Social Network Sites that primary focuses in providing video streaming on television channels as well as Recorded televisions programmers library with in network. Social Network based on Televisions provides users of same interest to connect with each other and share television contents between them and get recommendation from friends and families.

#### **4.2.7 Framework/Programming Language**

There are various types of programming languages and frameworks present to develop sites but not all languages/frameworks are suitable for the development of Social Network Sites some of the most popular languages that has been use for the development of the Social Networks Sites are PHP, Ruby on Rails, Asp.net, Java and Python. There is still no definite answers about what social network uses what languages at server end but it's an obvious that most of the big sites uses combinations of languages.

The main characteristics that programming languages should have for the development of the Social Network Sites should be Following:

- 1) Real Time supporting language
- 2) Scalable and lightweight
- 3) High Concurrency Rate
- 4) Low Response time

#### **4.2.8 Supports Cloud Services such as (EC2 or Azure)**

Therefore author have selected Node.js as language of preference its quite new and looking promising in terms of characteristics. Furthermore using node.js can be very encouraging in terms of investment. It's cheap, open-source, based on widely use and popular programming languages (JavaScript and C++ native) , which means front-end developers can also contribute their part at back-end without hesitation and no need of hiring two different teams for Front-end/Client-side and Back-end/Server-side, it has socket.io module for the development of real-time application and very flexible, robust and simple for doing complex tasks.

### **4.3 Storage System / Databases**

There are various types of databases available now a days, it can be categories into 3 main categories by storage type data. Structured data, Un-structured data and semi-structure data storage systems through case studies of existing Social Networks authors have highlighted high preference databases.

### **4.3.1 Structure Data Storage Systems**

#### **4.3.1.1 MySQL**

Which is high performance RDBMS opensource and widely used by social networks for storing structured data, Social Networks like Facebook, LinkedIn, Flickr and YouTube are main user of MySQL.

#### **4.3.1.2 MS SQL Server**

It's another RDBMS used by MySpace for storing structured data which is not commonly used by Social Networks because of Licensing and average performance.

#### **4.3.1.3 PostgreSQL**

PostgreSQL is another high performance RDBMS widely used by social networks after MySQL, Hi5 is one of the prime user of this database.

### **4.3.2 Unstructured Data Storage System:**

#### **4.3.2.1 Cassandra**

It is a custom product designed by Facebook for storing unstructured data, It is open-source and Distributed, Key-value store special designed for the social networks sites and Now a days widely used by social networks such as Facebook, Twitter, Reddit etc., It is also being reported that Facebook and twitter are using Cassandra as a main storage system instead of MySQL.

#### **4.3.2.2 Memcached**

Memcached is memory distributed key-value store that widely used by social networks for storing unstructured, mainly use for caching data rather storing data. Major users of the Memcached are Twitter, Zynga, Facebook and Wikipedia.

#### **4.3.2.3 Redis**

Redis is one of the latest and fast growing open source key value stores, it widely known for distributed and fault tolerance data caching. It is another alternative of Memcached. Redis mainly use dictionary terminology rather store for marketing, since main focus of the Redis creators is to provide data-structures for storage. You can find several of collections in it for storage such as Hash, List and Sets. The main users of Redis are Twitter, Github, Digg, StackOverflow and Flickr.

#### **4.3.2.4 MongoDB**

MongoDB is an open source document oriented database, it provides high availability, highly scalability, replication with auto-sharding and map/reduce functionality. It saves data in form BSON objects which makes it faster and can deliver data on real-time bases. Currently Foursquare primary using MongoDB for storing geospatial data.

#### **4.3.2.5 Polyglot**

As it rightly said "one size does not fit all sizes" author came to conclusion of forming

a polyglot system for storage. This is not an unusual, many social network sites focuses to form polyglot of databases so that their system can get best of everything.

#### 4.3.2.6 Redis

Redis for caching real time data, to provide real time Instant Messaging and auto fill search queries for NGSN, this also can be done through Memcached but author preferred Redis over Memcached because of its documentation and also little better benchmarks with few exceptions.

#### 4.3.3.7 MongoDB

MongoDB is always one of the fascinating NoSQL database, it is distributed and fault tolerant and still fast enough for storing unstructured data with good scalability. This storage system provides storage of large amount unstructured data, such as videos, pictures and geospatial data. Other characteristics of MongoDB are Real Time storage and High availability.

#### 4.3.3.8 Neo4j

Neo4j is a graph based storage system which provides distributed and ACID compliance storage; Neo4j is one of the most popular graph database that has created yet it can store data with complex relations, the main purpose of selecting this is to avoid RDBMS which is much slower , to enable graph search option and to analysis social behavior of its users in order to display contents based on the ethnics groups, community or people of same interest etc.

#### 4.3.3.9 AllegroGraph

AllegroGraph is an RDF store that integrates wins MongoDB, It one of the best RDF store based on benchmarks. Author had three choices either use existing neo4j database for RDF storage, custom develop a RDF store or use existing RDF storage. Using Neo4j for RDF store is not recommended it has poor benchmarking, designing custom solution will be costly, and therefore author used AllegroGraph.

### 4.4 NGSN Architecture

Prototype of existing architecture of Social Networks such as YouTube, Flickr, Facebook, MySpace etc., described in figure in a form of key components.

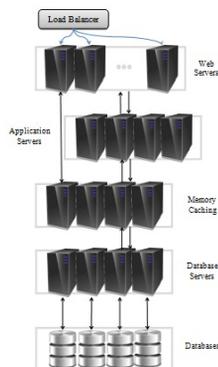


Figure 19: Architecture for huge Social Networks

#### 4.4.1 Web Servers

Webserver in such systems considered as an important so that it can provide service without getting overload, to avoid overloading they create web farms consisting many servers running at a time, to provide high performance service. Gigantic use of servers many sites uses load balance or reverse proxy to divide load among the installed web servers in web farm. Webservers also use extra layer of application servers for security purposes.

#### 4.4.2 Main memory Cache

Many sites use memcaches broadly. Memcaches is an in-memory storage based on hash tables. It has become important part of the social sites architecture to meet the performance and scalability needs. Many major sites use memcaches to store most frequently access data.

#### 4.4.3 Databases Portioning and Replication

Many major sites partitioned their data based on its services for example emails, audio, videos, pictures, news and members profile etc. Many sites keep various copies of all the databases to ensure performance, scalability and availability of data.

#### 4.4.4 NGSN Architecture Design

Through results of Survey and Literature Review author came to conclusion with the following architecture.

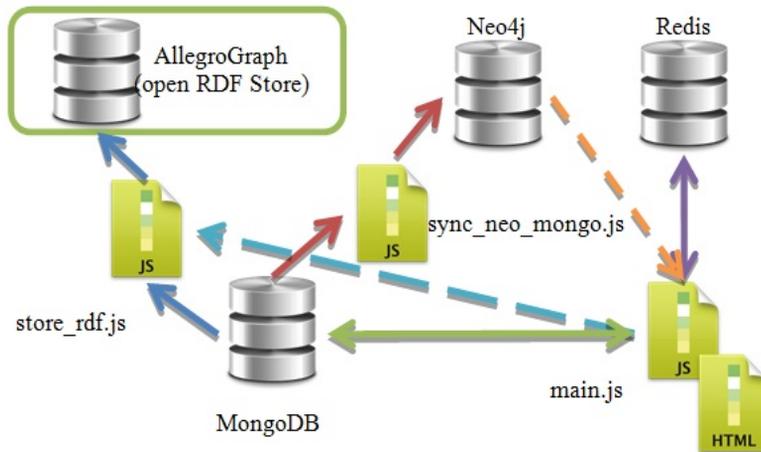


Figure 20: Next Generation Social Network Architecture

As author already discussed that his language of preference is node.js which is purely based on JavaScript, diagram above shows the overall architecture of the system. In diagram the most important file is main.js, which is the main core file that communicates with databases and renders HTML, main database that we used here is MongoDB which

directly accessible by main.js file. Whenever data updates, inserts in MongoDB it triggers event to sync\_neo\_mongo.js which is responsible of syncing data from MongoDB to Neo4j. Main purpose of using Neo4j is to enable social graph analysis for the system and also to provide graph search. Redis is another database that author have used in his architecture this databases is being use to cache frequently use data, also to provide service of instant messaging and to autocomplete search box queries in real time through socket.io. While AllegroGraph is being used to provide open Linked data service for semantic purpose which is being controlled by main.js in order to protect private data and privacies protected things of individual user. This architecture is an abstract of Eric Redmond's Circus.

## **CONCLUSION**

Although research was supported by many researches and social network analysis but it still needed to be validate through complete development of social network that based on video, images, and content sharing with geospatial data and RDF storage of each of its publicly shared data. Though author has used Allegro Graph for RDF storage but another prospective can be of custom development of RDF stores through MongoDB, so that whole project will shape into unified open source, and cheap in terms investments.

Through literature search author came to conclusion that above suggested system can be used in general to any type of social network, this architecture is theoretically flexible enough to accommodate any change and provides high performance, high scalability and high availability, with any type of data, structured and unstructured data at very cheap rate and semantic web features makes it unique and futuristic.

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