



# INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

ISSN: 2454-132X

Impact factor: 4.295

(Volume 5, Issue 1)

Available online at: [www.ijariit.com](http://www.ijariit.com)

## Survey of mobile social network middleware: Data dissemination, routing and forwarding, and social awareness

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### ABSTRACT

Due to the increase of the internet of things, there are different techniques and systems are developed, from this technology one is a Middleware, for Mobile Social Network (MSN). MSN is the intersection and combination of social network and mobile communication. This paper summarizes about the different types of Middleware that are applied on MSN for Data Dissemination, Routing and Forwarding, and Social Awareness. The target of this paper is to criticize middleware's grounded on their characteristics, platform that they implement it and also based on architecture. In this paper different practises are such as location-based mobile social matching and place-based ad hoc social practices, and based on their result of response for a different amount of user are discussed, in addition to GIS (Geographic Information System), LBS and J2ME technology are used.

**Keywords**— Data dissemination, Routing and forwarding, Social awareness

### 1. INTRODUCTION

Middleware is a protocol it enables to communicate two separate device/program. There are different types of middleware that make the mobile device functions in a different area with different activities especially in social computing applications Facebook, Myspace, LinkedIn by enabling social Networking and computing. Social Networking focuses on how users communicate with each other based on their interest.

The middleware for MSN should address the constraint of mobile devices like limited power source, low memory capability, limited processing, and heterogeneity. MMSN (Middleware Mobile Social Network) is responsible for managing user information and provide control policies for the exchange of data. This review paper present on different protocols that provides support for programming and Mobile Social Computing (MSC) applications for different activates [1] that are listed below. The two gay oval shapes those have some have a knowledge gap, the Diamond diagram as the hybrid system (MSN) that is derived.

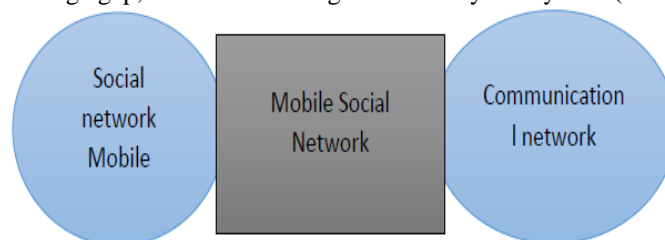


Fig. 1: MSN architecture

### 2. MOBILE SOCIAL NETWORK MIDDLEWARE'S

#### 2.1 MobiSoC

MobiSoC [3] middleware is a known platform for managing, capturing, and sharing of the social state of the community. The community are communicated by a logical concept. It makes bounders for collecting user need and places. It is a centralized architecture to collect people/place profile this it allows the scope of creation both user-centric and place-centric MSN view. It adopts a learning algorithm that tries to detect previously unknown ad-hoc group and their associated meeting places, and it gives a simple solution for privacy management and enforcement. This state is composed of people profiles, place profiles, people-to-people affinities, and people-to-places affinities [3].

**2.1.1 Data dissemination:** MobiSoC runs on trusted servers and provides a simple API for developing MSCA's (Mobile Social Computing Application's).

The people sub-module allow the application to collect, modify, and store the user profile. This sub-module can introduce new user, add a new user, and maintain social network regarding on the given information. Place sub-module support the collection of geographical data and map for any things like building, office, window etc. the Location sub-module stores any information about the location by using GPS (Global Position System). The user determines the social network information from the central server. Any update is simultaneously sent to middleware.

**2.1.2 Routing and forwarding:** MobiSoC applied on MSCA, it depends on the critical number of user who shares the file, place, and real-time location information, and compute their routing and forwarding by: first: it creates (i)Dynamic tie between the user and between user and place (ii)model, validate, and store those tie (iii)effectively share community data among multiple application. Then provides infrastructure support to collect real-time user location in a scalable manner for sharing the packets.

**2.1.3 Social awareness:** The MobiSoC successfully understand and identify the geo-social pattern, and it takes a community-centric approach. For mobile users, the middleware identifies the people/place of the society by their geo-social relationship and social ties.

## **2.2 MobiClique: Middleware for mobile social networking**

MobiClique is designed and operates in mobile ad hoc network, Bluetooth enabled the device to communicate with each other. It allows for the user to maintain and extend the social network by user-centric MSN's, and it is decentralized architecture relies on a connection between neighbour (local spatial scope) [4].

**2.2.1 Data dissemination MobiClique:** It is applied and form an ad hoc network by using store-carry-forward technology to disseminate the content. MobiClique goes beyond device to device exchange. This offer an interesting framework for collaborating, dissemination and forwarding data's.

**2.2.2 Routing and forwarding MobiClique:** For route and forward each device have a social profile, personal information, list of a friend, and social group of interest. Its routing is neighbour identification is based on either Bluetooth (MAC address). Each MobiClique node executes the periodic loop for data exchange consist of the following steps:

(i) Neighbourhood discovery (ii)User Identification and (iii)Data exchange The live of a message in MobiClique is identified by TTL(time-to-live) the data can deliver either Unicast message or Group message.

**2.2.3 Social awareness MobiClique:** MobiClique associates mobiles device, to associate each device they must meet the predefined relation or interest if the interest is meet they can join to the existed social network. The social graph depends on if the unknown friend is a member of the existing social network simultaneously the graph will expand. Their social awareness of each device by using different profile format, like Friend-of-a-Friend (FoaF), Social graph API or Open Social.

## **2.3 SAMOA**

SAMOA (Socially Aware and Mobile Architecture) [5] middleware supports the creation of anywhere anytime MSN's. Depends on user movement which means it can be centred by the user, and the user has full control of his/her social network, guideline, and scope of MSN's. This middleware also supports the place-centric association.

**2.3.1 Data dissemination:** The framework support for anytime anywhere, disseminate the messages first the middleware mobile user captures the existed social network to his/her mobile (device) with different specification like location-based, user based, and rules that are specified by the ego-user, then the new should have to a member to share/disseminate the data.

**2.3.2 Routing and forwarding:** It is some Decentralized architecture the mode of sending and receiving depends on ego-user manager, the user can send as unicast or multicast, and the host must be located in a specified boundary. To communicate one SAMOA to another is by broadcasting a message to other SAMOA entity which is allocated the same place.

**2.3.3 Social awareness:** The ego-user specifies different rules and post it in public, in place-centric the middleware it makes a group user who found in location to share the common characteristics.

## **2.4 MoViShare: Building location-aware mobile social networks for video sharing**

MoViShare (Mobile Video Share) is it same with SAMOA applied at anywhere anytime for universal video sharing platform on video browsing and publishing service for mobile device [6]. It's an advantage is to save energy and bandwidth because it creates and maintains a location-aware mobile social network. Its technique is called sample-based which takes the frame (I-frame) from the video and merge them together as a .gif image.

**2.4.1 Data dissemination of MoViShare:** This Middleware is user location-wise to route the message in the existed social network mobile user can know where other users are, what amount of distance is far from, and they visualize their location by image and videos for sending a message.

**2.4.2 Routing and forwarding of MoViShare:** It accepts both unicast and multicast mode of communication to route and forwards the message.

**2.4.3 Social Awareness of movie share:** Because of MoViShare create and maintain location-aware social network each client explore their mobility for utilizing location information. Depending on the current location and video quality a user can search for videos. In addition to this, a user adds upload video/image files to the system to share with others through MoViShare.

### **2.5 MobiSoft: An agent-based middleware for social-mobile application**

Like the above middleware's this also used for facilitating, sharing, and integrating user on the social network during face-to-face encounters [7]. This middleware is same with SAMOA which allows for user's to establish a group and community based on user's interest to join to the existed group, to share information, and the preselecting. It Outlines a decentralized peer-to-peer based architecture.

**2.5.1 Data dissemination:** To spread to the message agent is developed for managing peer-to-peer communication in MANET (Mobile ad hoc network) then the agent develops hybrid information for exchange technique, and finally, a method is developed to describe user's profile, interest and information.

**2.5.2 Routing and forwarding:** It uses Unicast and multicast communication mode, for sharing of information. It sends the message to the specific place and specified boundaries, an example in a shopping mall, stadium, and museum.

**2.5.3 Social awareness:** Agents will communicate with each other and a pair agent can notify their respective owner the agent is called social-mobile assistant. The social-mobile assistant can exchange information like user/private profile, news, and social patterns.

### **2.6 The MAgNet: Agent-based middleware enabling social networking for mobile users**

The MAgNet [8], a middleware based on software technology that enables social networking service (SNS) for users in the mobile network domain. The mobile user can enable by using it to define and customize their social relationship with other users, and he/she can also use the existed relationship to plan and manage group events.

This middleware divided the service into two groups

- Creating and Managing Users
- Planning of event groups

It uses additional software agent for a description like a Resource Description Framework (RDF) and Friend-Of-a-Friend Vocabulary (FOAF) [13] and to implement the MAgNet middleware technology to integrate SNS's and mobile user.

**2.6.1 Data dissemination:** The user's profile and the information are stored with in users profile, the profile is managed by MAgNet middleware. They are managed by different frameworks like Resource Description Framework (RDF) and Friend-of-a-Friend (FOAF).

**2.6.2 Routing and forwarding:** Agents are can react dynamically to rout and forward the message becoming of dynamic interaction it makes the network robust and fault-tolerant. It is both Unicast and Multicast routing, the sender(Social network) can send messages to the receiver directly through User Agent(Unicast), or Social Agent can distribute messages(Multicast) to the existed users agent and the user's agent forward it specific user(Unicast).

**2.6.3 Social awareness:** The social awareness of users is here SNS allows for the mobile user to create a public or private profile and give the opportunity to another user to connect with him/her. The creator of this SNS view's their list connection and what the member does with in the system.[9]All message exchanged within the middleware sending friend request, accepting or rejecting received friend request sending event invitations and event notification. Users should to create his user profile by using application profile, it is Java-based application Whose graphical interface size fit the mobile device screen size, then User Agent (UA) obtain information from the created user profile act on behalf of the user. To ensure user privacy MAgNet enable users to use a block list.

### **2.7 MY-DIRECT: a middleware for p2p mobile social networks**

My-direct middleware applied in a mobile social network which makes use of Wi-Fi Direct technology [9] to connect mobile device (Android) platform together by Bluetooth aiming to provide flexible communication between mobile devices. It also created a mechanism for user privacy based on information available on his mobile device. For coordination and management of the social network My-Direct use two managers.

- Wi-Fi manager - Is responsible for accessing of Wi-Fi Direct on a mobile device to monitor the network status.
- Bluetooth manager:-is responsible for monitoring and operating resource related to Bluetooth technology.

**2.7.1 Data dissemination:** To make functional the p2p communication by My-Direct middleware is divided into three modules.

- Communication module used for a mobile device which is nearby, for Enabling the association and communication in the social network.
- Privacy module
- Persistence module:-this module is responsible for storing user's personal data and its partner in Database Management System (DBMS), it makes it easy to search for information that is allowed to a partner.

**2.7.1 Routing and forwarding:** MAC(Media Access Control) address is used to identify mobile device because of its unique identifier, each mobile device communicate to each other in unicast and MAC address is stored from both sides. Also, the phone

number is used as a routing path that mobile device not identified by MAC address. The communication between nodes is accomplished by combining two ad hoc network technology. This middleware has (P2P) peer-to-peer architecture in a decentralized way for forwarding a message there must support p2p via Bluetooth and/or Wi-Fi, But it is not full decentralized it has some Client/server architecture when a mobile device is not identified by MAC address, it sends a request to DBMS server and server responds to the client's request.

**2.7.2 Social awareness:** The user of social network builds over My-Direct for performing a social activity with in his/her partner via Bluetooth having more probable of failure and through Wi-Fi Direct. To check the degree of the link between users there should be access online social networking sites. First find a partner which is found nearby, after he/she gets a partner to establish a connection with a partner for share message (image, text).

### **2.8 iZone: A location-based mobile social networking system**

iZone [10] an MSN middleware it collects and combines spatial data and displays to mobile, which have the same function with Google map it captures geographical data by using different platform GIS(Geographic Information System), J2ME and display to the smart phone.

**2.8.1 Data dissemination:** IZone can collect position data and other information by selecting specific things that are interested in the user finally send the data in the human understandable form. With centralized architecture. There were two basic types of mobile social networks for message dissemination.

- Companies that partner with wireless phone carriers to distribute their communities via the default start pages on mobile phone browsers. Then each community get the message.
- And Companies that do not have carrier will relay on another method to attract the user.

**2.8.2 Routing and forwarding:** It is client-server architecture by which have four main components

- Client device: it has a location module for receiving and sending the data.by using Wi-Fi or GPS to identify or estimate the current location of the user.
- Wireless Access Network: is an infrastructure the user the information from a base station.
- Internet: used as a bridge to access the database (base station).
- Server: is a core the system it stores the message (DBMS).

### **2.8.3 Social awareness**

To use this system first the user must register, the user fills username, password, email, phone number, and gender. After registration, the server sends a message to the user to log in by username and password sated by the server. Finally, the user gets the default subsystem map which having have location-based system, the location-based system consist of local search like local hospital, restaurant and on-line friend module used to search the user can see others nearby user on the map of certain user information. For finding a new user, he/she choose to search and find a friend by username, city or interest.

### **2.9 Implementation of CAMEO: a Context-aware middle- ware for opportunistic mobile social networks**

Opportunistic [11] MSN address a vast area that is applied in different domains like healthcare for environment monitoring and urban sensing by implementing the concept of context-and Social-aware. The core function of this middleware is grouping together of users and their mobile device to characterize the context information like interest, pattern and user profile and device information like Model, internal resource(sensor) what application that are run. Its focuses on managing and explanation of context information for implementing to optimize the network and context-aware application for the opportunistic network.

**2.9.1 Data dissemination:** There is a module called Beacon, periodically sends on the network hash value of the context component of the local node and receives those of neighbour. CAMEO has two parts internal and external in order to collect information of the local user which is managed by internal CAMEO interact with the external CAMEO authorizes the distributed information in the network. Finally, CAMEO interacts with each other by the Android platform.

### **2.9.2 Routing and forwarding**

Internal service of CAMEO (eg forwarding protocol) exploit the data to optimize its feature. It is used the link-state-routing protocol to route the message, it sends the context information to the destination by selecting the best next hope for that message.

**2.9.3 Social awareness:** Its social awareness is implements optimized procedure based, identification of context component though hash value and by the creation of social context of each node obtained through exchanging of context information among physical neighbours.

### **2.10 Privacy-preserving matchmaking for mobile social networking secure against malicious users**

The unique characteristic this middleware is proposed for secure against malicious users, it focus on interest-based matching, and it is more secure than the others above middlewares. This matchmaking protocol for MSN is based on the following principle.

- Ensuring privacy by closing unnecessary information (the information that does not match the interest) to the other user.
- After matching participant's interest no need to depend on the trusted server, and the user does not need an internet connection (they communicate by Bluetooth)

**2.10.1 Data dissemination:** It is for mobile social networking that potentially a malicious user learn only the interest that he has in common with the nearby user. It is based on Bluetooth which is used for short message communication technique.

**2.10.2 Routing and forwarding:** The routing procedure this protocol have the same behaviour of MY-DIRECT for sending and receiving the message they must know each other their MAC(Media Access Control) address and it uses link-state routing algorithm.

**2.10.3 Social awareness:** It is centralized architecture, there is a trusted server (trusted third party) that contains user profile and matchmaking performance. Based on this the server computes another user information which is found nearby. Then the first user will be notified by the server, the other person which have the same profile(matchmaking) will aware the network, and also the server searches another user which have the same information with two users. The awareness of the system is growing like this.

**2.10.4 Security issue of the middleware:** The protocol is based on asymmetric key-based cryptography. Since it uses Bluetooth for commination the attacker can trace by knowing the flow of message locating nearby the victim user. This protocol protects from an attacker by the following procedure:

- By learning user's interest without any hesitation.
- By exploring user interest including all possible elements.
- By exchanging user signed certificate

### 3. COMPARISON OF THE PROPOSED MIDDLEWARE

To summarize the Middleware's based on platform, architecture, and their behaviour (user or palace centric) the given table below.

**Table 1: summery of middleware for Mobile Social Network**

MSN middleware	User/place centric	Architecture	Platform/language
MobiSoC	Both	Centralized	java on Apache server
MobiClique	User-centric	Hyb rid	C++ and C sharp
SAMOA	Both	Decentralized	java on a virtual machine
MoViShare	Both	Decentralized	Microsoft .Net2.0
MobiSoft	Place centric	Decentralized	Java-based Tracy2
MAGNet	Both	Decentralized	Java Agent Development
MY-DIRECT	User-centric	Decentralized	Java, XML, and IDE
iZone	place-centric	Centralized	java
CAMEO	Both	Hybrid	Android Java

### 4. EVALUATION AND CRITIQUE OF THE MIDDLEWARE

Most of the Middleware that is listed in the above they are near to project like developing a system for chatting and searching for location done in Jimma university 2016 but not all. My recommendation from this article to do such as researches, and force to us to write a research paper by hybridizing two or more middlewares.

### 5. CONCLUSION

There are different Middleware approach for MSN that is described in the above, each proposed to a different solution or the same with the different or same platform. Due to the development of technology and incremental growth of industries (the development of smart phone) different researcher forces to write the knowledge gap or unsolved problems like MSN middlewares. The middleware helps to solve some constraint of smart phone.

$$\text{Social Networks Mobile} + \text{Communication Networks} = \text{Mobile Social Networks (MSN)}$$

The general function of this middleware is for designing and providing efficient and effective data communication.

### 6. ACKNOWLEDGEMENT

I would like to say thank for Dr Ahmedin Mohammed who guides during writing this survey paper, and those who write articles and share to public user.

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