Evolution and Application of General Attribute and Multiple Registration Protocol – A comparative study

UROOJ WAHEED[1], M. SADIQ ALI KHAN[2], HIRA ANWAR KHAN[3], SAMIA MASOOD AWAN[4], YUSRA KHALID[5]

[1]Ph.D. Scholar, [2]Associate Professor, [3]Lecturer, [4,5]Research Associate,
[1,2,4,5]Department of Computer Science, University of Karachi,
[3]COCIS, PAF-Karachi Institute of Economics and Technology,
[1,2,3,4,5]Karachi, Pakistan

Abstract
The standard for 802.1Q has been generally recognized by the communication networks administrators. This standard has been used since its commencement. Presently a revision (ak: seventh) has assumed control over its essential order of Generic Attribute Registration Protocol (GARP) by another convention known as Multiple Attribute Registration Protocol (MRP). This paper evaluates both (GARP and MRP) protocols and define the reasons of replacement of GARP by MRP. It also discusses two applications of GARP and MRP namely Generic VLAN Registration Protocol and Generic MAC Registration Protocol, Multiple VLAN Registration Protocol and Multiple MAC Registration Protocol respectively. In this paper, comparative study is done based on GARP and MRP.

Key words:
GARP, GVRP, GMRP, MRP, MMRP, MVRP, STP, RSTP

1. Introduction

The standard for 802.1Q has been widely acknowledged by the communication networks administrators. This standard has been utilized since its inception. Now an amendment (ak: 7th) has taken over its basic classification of Generic Attribute Registration Protocol (GARP) by a new protocol known as Multiple Attribute Registration Protocol (MRP) [4]. This paper evaluates both (GARP and MRP) protocols and define the reasons of replacement of GARP by MRP [8]. It also discusses two applications of GARP and MRP namely Generic VLAN Registration Protocol and Generic MAC Registration Protocol, Multiple VLAN Registration Protocol and Multiple MAC Registration Protocol respectively [1].

As all these protocols use Spanning Tree Protocol (STP). Ethernet relies on a spanning-tree approach (Spanning Tree Protocol (STP)/Rapid Spanning Tree (RSTP)) to perform forwarding. STP gives the means to provide a simple but non-optimal forwarding, by performing loop avoidance. [3]. STP creates a logical topology in the form of a spanning-tree where the path from every node to the root bridge is a shortest-path in the form of a min-cost (cumulative link cost) path. The choice of the bridge that plays the role of root therefore strongly dictates the efficiency of the resulting logical topology. Hence, there is no guarantee that the path between any two nodes is a shortest-path [17].

The content is adjusted as takes further. Firstly, review of the writing has been finished. Taken after by essential blueprint structure about its underlying concept. Proceeding onward to the GARP architecture and applications. Sending towards the MRP architecture and application. In conclusion closing the entire content.

2. Literature Review

The topologies which are discussed in this paper are based on Local Area Networks. Derived by the LAN and WAN committee; IEEE. [1]. As far as the basic operations are concerned Bridged Local Area Networks (bridged LAN) are implied for standards 802.1Q and 802.1ak [5]. Bridged LAN use Spanning Tree Protocol (STP) for creating and maintain active topology [8]. GARP uses STP and amended MRP uses a newer version of STP named as Rapid STP (RSTP) [2]. In this section, both the underlying topologies are explained.

2.1 Spanning Tree Protocol (STP)

If two or more bridges or switches are connected with each other will create a problem of topological loop [19]. This made difficult for the communication between bridges to decide he route among multiple path for same destination [3]. Spanning Tree Protocol blocks some ports from the network so that topological loops can be avoided [19]; still all nodes in the network are connected physically, and are known as blocked ports, which are ready to participate in communication when the active link down occurs [16].

The problem may occur in STP when changes to network devices are made (MAC address changes, turning on/off bridges, etc.) [5]. The bridge which knows about the change in topology, tell the Root Bridge about TC (Topology Change) [2]. This problem was solved by using

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special frames known as Bridged Protocol Data Units (BPDU) [11]. Used for making and maintaining the spanning tree [12]. The tree starts from a node known as the "Root Bridge". BPDU was only generated by Root Bridge and broadcast to all the members in topology. [6].

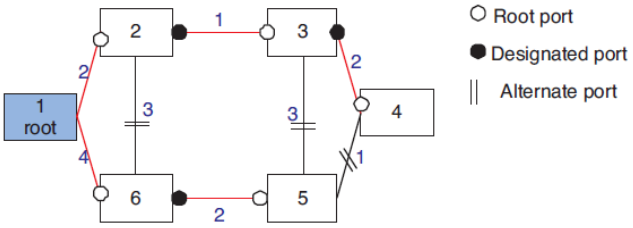

Fig. 1 Spanning Tree Protocol

Spanning tree can have multiple routes in a network [14]. The path is selected using a least cost method. That is the choosing the least paid Mbps route. [1]

Root Bridge sends HELLO after every 2 secs, for insuring about the members present in the topology [20]. If non-root port didn't receive HELLO for 20s (10* HELLO), that non-root port started to act like root bridge and stared sending BPDU. Following is the operation of STP. [7].

There are five states for STP Blocking, Listening, Learning, Forwarding, Disabled [3]. The state transition diagram below illustrates the relationship among these states [9].

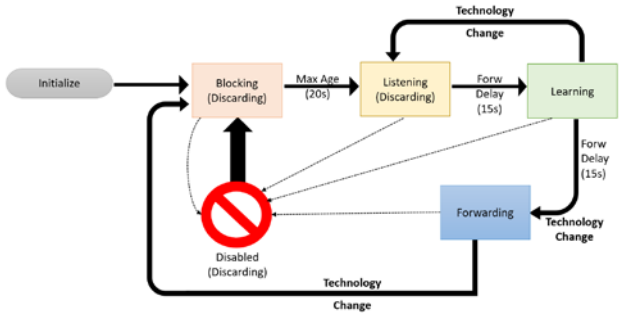

Fig. 2 Solid arrows illustrate the normal activities of the STP, dotted lines show the states if any network administration changes occur.

2.2 Rapid Spanning Tree Protocol (RSTP)

When change in topology occurs in a STP it is received in a certain time by knowing a failure in receiving a BPDU [15]. If the timeout is immense, convergence time would be larger than that of a required. [13]. For this purpose, RSTP (Rapid Spanning Tree Protocol has been defined). 802.1D (2004) illustrates the advancements in STP and is called RSTP [20].

BPDU is generated by all bridges present in topology. For synchronization in topology it uses proposal and agreement mechanism. [9]. It is faster than STP because it has no learning state which saves time. In RSTP whole topology gets flooded by TC (Topology Change) [2]. TC information passes on by bridges to its neighbors [19]. When change in topology occurs in a STP it is received in a certain time by knowing a failure in receiving a BPDU [12]. If the timeout is immense, convergence time would be larger than that of a required [1]. Non-root bridge before acting as ROOT waits only 6 sec (3*Hello) for advertisement from root [8].

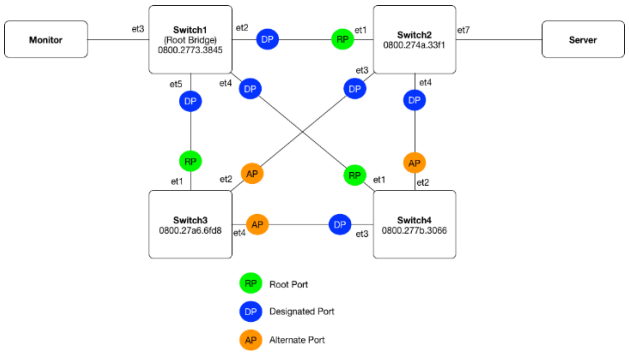

Fig. 3 Spanning Tree Protocol Mechanism

RSTP enhancements are;

1) Monitoring ports status and when a topological failure occur an immediate topology change is guided [6].
2) Also, the number of states from STP has now shrunk to 3 in RSTP namely discarding, learning and forwarding. In RSTP discarding state has replaced listening, blocking and disabled states of STP [6].
3) It also creates new Port roles known as Alternate Port, which is a backup port, which works immediately if a root port malfunctions [6].

3. Related Work

3.1 Generic Attribute Registration Protocol

GARP stands for Group Address Registration Protocol, now known as Generic Attribute Registration Protocol [2]. It defines rules through which end stations and switches exchange information or attributes (network identifier, addresses) for registering / De-Registering with one another with in a LAN [17]. The Attributes are broadcast to the devices with in a LAN through a topology which was created by Spanning Tree Protocol (STP) and is referred as active topology. Devices don't use GARP directly, but through its applications, which using attributes perform important task [9].

3.1.1 GARP Operations

The following figure shows GARP architecture.
LLC service by the use of defined PDU format and group MAC address exchanges the protocol between GARP Participants [5].

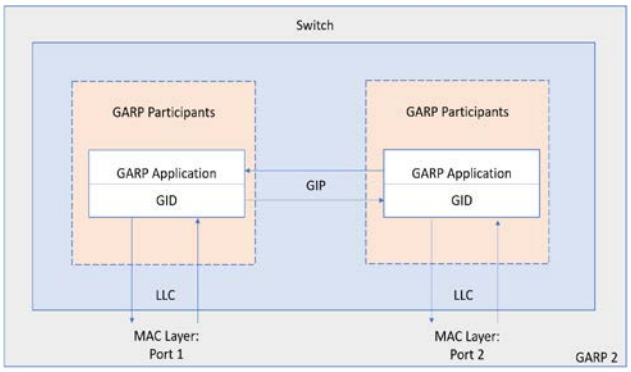

Fig. 4 GARP Architecture

GIP (GARP Information Propagation) component is responsible for broadcasting of information between GARP participants for same application. MAC address and PDU format used for protocol exchange between GARP Participants [4].
Database is maintained to store values of instances of GARP's attributes and these attributes are stored as GID (GARP Information Declaration) indexes [6]. Registration and declaration state of all attributes of GARP Participants defines by the instance of GID which is defined by state machine [1]. Applicant and registrar have different state machines. The following figure shows the GID architecture [9].
GARP Participants sends JoinIn or JoinEmpty messages for declaration (applicant registration). And send LeaveEmpty or LeaveIn message for withdrawing a declaration (applicant de-registration). After value deregistration of participant several empty messages are generated which indicate other members to send JoinIn or JoinEmpty messages for declaration. Lost messages are controlled through LeaveAll message. Generation of events and control of state transition are responsibility of Timers [8].

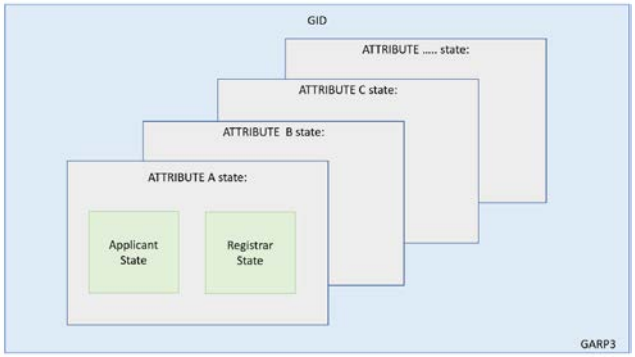

Fig. 5 GID Architecture

The job of the applicant is to ensure that:

1) The participant's declarations are registered by other participants' registrars
2) Other participants have a chance to re-declare (rejoin) after anyone withdraws a declaration (leaves).

To make sure about the registration and deregistration of an attribute is the task carried out by Registrar [18].
An Application state machine is controlled by The Applicant Administrative Control parameter. This parameter figures out about the participation of the state machine in GARP protocol exchanges [12].
The Registrar State machine is controlled by The Registrar Administrative Control parameter. This parameter figures out about the listening of incoming GARP messages [5].
GARP Information and Propagation (GIP) component in a switch for same application broadcast the information among GARP Participants. GIP allows only those ports to register in a member's circle which has forwarding state assigned by STP. All members in circle get notified about the attribute registration and de-registration through GARP Information Declaration (GID) Join and Leave Notification [3].
GARP Application is only added to GIP member circle when the port to which GARP Application belonged is active and in forwarding state [12]. Newly added port in a GIP member circle get notified about the attributes registered of other ports through broadcasting. Member of GIP circle as well notified about the attributes of newly added port in the process of broadcasting [18].
GARP Application leaves from GIP member circle when the port to which GARP Application belonged is active and leave from STP forwarding state. GID Leave request is broadcast to the GIP Member Circle before removal [13].
GARP has two applications through which it is used. It is defined as follows.

A. Generic MAC Registration Protocol (GMRP)

GMRP uses the application of GARP, GMRP describe a procedure through which end stations and bridges are registered for group membership. Switch and end station both being run by GMRP software component. IGMP is basic for GMRP. IGMP snooping is the way through which multicasting is managed without any additional software on host. [10].
GMRP joins message is initiated by host query to join IP multicast group. For this purpose, IGMP join message creates when then enable GVRP to generate message. After receiving join message from GMRP the port on switch is added in multicast group through which the request is send [2]. Through multicasting method switch tell other members (only to those ports which already send join message to switch) of group about the newly join member of group [5]. GMRP query is generated and send to all group members periodically, switch don't perform any action if the group members want to remain in group they respond to that query. [11]. But in contrast if the switch doesn't get response for query from host for the timer duration or gets response with Leave Massage than switch removes the host from multicast group [6].

B. Generic VLAN Registration Protocol (GVRP)

Administration and Configuration of VLAN is difficult task due to the expansion in network, which cause increment in number of clients of VLAN. GVRP is the solution for the dynamic administration as the topology change occurs [7].
GARP application protocol is GARP VLAN Registration Protocol (GVRP). Switches and end stations in a VLAN is register and de register through protocol called GVRP. GVRP protocol makes easily to control VALNS which spread over large network. [14].
GVRP based on the specification which defines tagging of Frames in addition to VLAN configuration data, defined by IEEE 802.1Q. Through this specification exchange of VLAN configuration with in network occur dynamically. GIP and GID used for description and propagation of rules for GARP application i.e. GVRP [15].

3.2 Multiple Registration Protocol (MRP)

Multiple Registration Protocol (MRP) was developed by IEEE described in 802.1ak (2007) an amendment made to 802.1Q. [4]. It illustrates the replacement of GARP, GMRP and GVRP protocol. MRP lets members present in a MRP application to make attribute registrations with Bridged Local Area Network participants. Each MRP application has its own definition of attribute types, values and semantics linked when registered [1].
Elaborately, MRP lets participants in a MRP application leave or make 'declarations' and these declarations are derived into 'registrations' of the attributes with other MRP members of the MRP application [11].

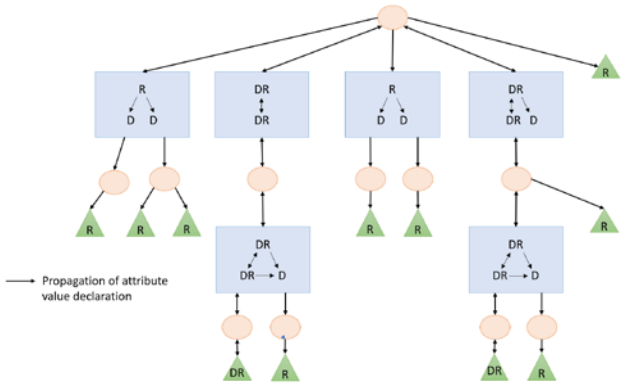

Fig. 6 Attribute Value Propagation from 2 stations

Applicant state machine is used for recording the Declaration for end station of MRP participants. MRPDU is used for insuring of Declaration or Withdrawal through change in Applicant State Machine's Variable [4].
Registrar Sate Machine is used for attribute registration at Bridge port and end stations. Attribute registration removal occurs when all LAN participants withdraw a declaration [14]. Attributes which are registered on Bridge port are also registered on other Bridge ports which are part of Active topology. That's why broadcasting of declaration is held in order to register application participants in each Bridge on the ports which are nearest to the source [19].

3.2.1 MRP ARCHITECURE

There are two components of MRP participants, an MRP application component (MAP) and an MRP attribute Declaration (MAD) component. [19].
Signaling for new declaration of attribute, semantic of attributes, and registration are the responsibilities of MAP. [16].
Generation of MRP message for transmission to other participants and apply processing on received messages from other participants are responsibility of MAD [1].
MAP component with in a Bridge broadcast information among per port participants. [20].
For each MRP application, the following are defined:

1) A set of Attribute types used by the application.
2) The Attribute values permitted for each Attribute type.
3) The semantics associated with each Attribute type and value.
4) The use made of MAP Contexts by the application.
5) The group MAC addresses and Ether Type for protocol exchanges between application

Participants.

6) The structure and encoding of the Attribute types and values in MRPDUs.
7) The requirements for MRP state machine support in end stations and Bridges.

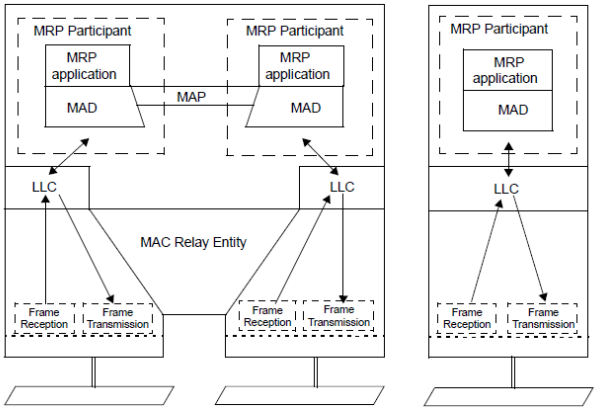

Fig. 7 MRP Architecture

A. Multiple MAC Registration Protocol (MMRP)

Registration of multicasting on multiple switches through group MAC address is achieved by MMRP. MMRP is the replacement of GMRP. MMRP restrict multicast traffic in LAN in specific area where required [16].
The information registered, deregistered, and disseminated via MMRP is in the following forms:

1. Group membership information. This indicates the presence of MMRP participants that are members of a particular Group (or Groups), and carries the group MAC address(es) associated with the Group(s). [13]. The exchange of specific Group membership information can result in the creation or updating of Group Registration Entries in the Filtering Database to indicate the Port(s) and VID(s) of the VLAN(s) on which members of the Group(s) have been registered. [17].
2. Group service requirement information. This indicates that one or more MMRP participants require Forward All Groups or Forward Unregistered Groups to be the default Group filtering behavior. [3,4].
3. Individual MAC address information.

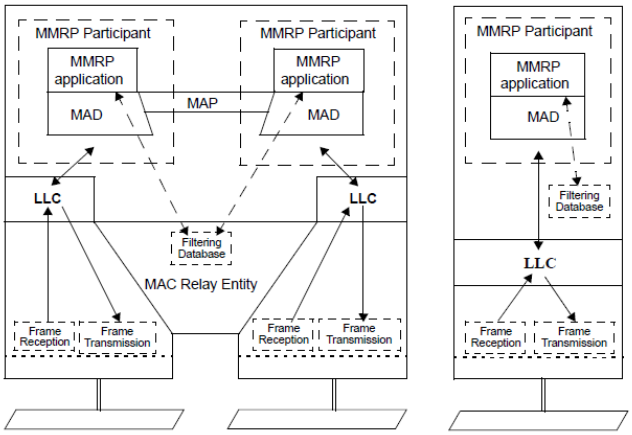

Fig. 8 MMRP Architecture

MMRP is an application of MRP that accomplish certain tasks:

1. Declaration and broadcasting of Group membership, services required, MAC address within lan, which is accomplish through MAP and MAD.
2. MAD offered registration services for group membership.

B. Multiple VLAN Registration Protocol (MVRP)

IEEE 802.1ak standard is used for MVRP [5]. MRP and MVRP are used to supersede GARP and GMRP because of its limitation. I.e. Large networks with large VLANs require large convergence time and more use of bandwidth [18]. Maintenance of VLAN configuration dynamically is responsibility of MVRP [4].

Different types of configuration are present:

1. VLAN membership information dynamically configure and distribute through MVRP
2. Management Mechanism is used for VLAN
3. membership information for static configuration. In some cases, both MVRP and Management Mechanism for combined configuration of static and dynamic [4].

In GARP and GVRP we use GIP and GID which is access through MAP and MAD in MRP.

4. Comparitive Study

Table 1: Difference between GARP & MRP

	GARP	MRP
ABBREVIATION	Generic Attribute Registration Protocol	Multiple Registration Protocol
RULES	GARP, exchange information or attributes (Network Identifier Address) Registering/De Registering with one and other within LAN	MRP, allow members in MRP application to make attributes registration with its own definition of attributes, types, values and semantics linked.
DEVICES	End station & Switches	End station & Switches
TOPOLOGY	Attributes broadcast to the devices in LAN through a topology created by STP and known as Active Topology	Attributes registration with other participants in Bridged Local Area Network
USAGE	GIP component is responsible for broadcasting of information between GARP participants not devices but its application uses attributes for important task.	MRP applications make declaration and derived registrations of the attributes with other MRP members of MRP application.

Table 2: Difference between GMRP & MMRP

	GMRP	MMRP
ABBREVIATION	Generic MAC Registration Protocol	Multiple MAC Registration Protocol
RULES	GMRP uses application of GARP, IGMP snooping is the way through which multicasting is managed without any additional software on host.	MMRP is the replacement of GMRP. MMRP restrict multicast traffic in LAN in specific area where required.
DEVICES	End Station & Bridges	Multicasting on multiple switches.
TOPOLOGY	Attributes which are registered on Bridge port are also registered on other Bridge ports which are part of Active topology	Declaration and broadcasting of Group membership, services required, MAC address within LAN, which is accomplish through MAP and MAD.
USAGE	Broadcasting of declaration is held in order to register application participants in each Bridge on the ports which are nearest to the source.	Information registered, deregistered and disseminated via MMRP. Group member information, Group service requirement information, individual MAC address information

Table 3: Difference between GVRP & MVRP

	GVRP	MVRP
ABBREVIATION	Generic VLAN Registration Protocol	Mutilple VLAN Registration Protocol
RULES	GVRP specify & defines tagging of Frames. Tagging makes exchange of VLAN configuration with in network dynamically	MVRP are used to supersede GARP and GMRP because of its limitation
DEVICES	End stations & Switches	End Station & Switches
TOPOLOGY	GVRP is the solution for the dynamic administration as the topology change occurs	MVRP rely on RSTP and MSTP, not on VSTP
USAGE	Due to the expansion in network, cause increment in number of clients of VLAN. GVRP is the solution for the dynamic administration as the topology change occurs.	Large networks with large VLANs require large convergence time and more use of bandwidth. Maintenance of VLAN configuration dynamically is responsibility of MVRP.

5. Conclusion

The topologies which are talked about in this paper depend on Local Area Networks determined by the LAN and WAN panel; IEEE. To the extent, the fundamental operations are concerned Bridged Local Area Networks (crossed over LAN) are suggested for guidelines 802.1Q and 802.1ak. Crossed over LAN utilize Spanning Tree Protocol (STP) for making and keep up dynamic topology. GARP remains for Group Address Registration Protocol, now known as Generic Attribute Registration Protocol. It characterizes controls through which end stations and switches trade data or characteristics (organize identifier, addresses) for enlisting/De-Registering with each other with in a LAN. GARP utilizes STP and changed MRP utilizes a more current variant of STP named as Rapid STP (RSTP), while Multiple Registration Protocol (MRP) was produced by IEEE depicted in 802.1ak (2007) an alteration made to 802.1Q. It delineates the substitution of GARP, GMRP and GVRP convention. MRP gives individuals a chance to exhibit in a MRP application to make property enrollments with Bridged Local Area Network members. Each MRP application has its own meaning of characteristic sorts, qualities and semantics connected when enrolled. Extravagantly, MRP gives members access a MRP application leave or make "revelations" and these assertions are inferred into "enlistments" of the properties with other MRP individuals from the MRP application. Candidate state machine is utilized for recording the Declaration for end station of MRP members. MRPDU is utilized for guaranteeing of Declaration or Withdrawal through change in Applicant State Machine’s Variable.

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Urooj Waheed She is currently a Phd scholar at DCS, UoK, having MSCS (2016) in Computer Science with specialization in Human Computer Interaction and Intelligent System. She is currently working as visiting faculty in Department of Computer Science – UBIT. Her main research interests are Security, Computer Networking, Human Computer Interaction.

Dr. M. Sadiq Ali Khan is working as Chairman and Associate Professor at Department of Computer Science University of Karachi since 2014, and currently a chair of IEEE computer society Karachi section. He has done his Ph.D in Computer Science with specialization in Network Security. He has about 20 years of teaching and research experience and his research interest includes Data Communication & Networks, Network Security & Cryptography & Wireless Network Security, IoT. M. Sadiq Ali Khan received his BS & MS Degree in Computer Engineering from SSUET in 1998 and 2003 respectively. He is member of IEEE, CSI, PEC and NSP.

Hira Anwar Khan She has done MS (2016) in Computer Science with specialization in Human Computer Interaction and Intelligent System. She is also an MBA in Supply Chain Management (2014) and MCS in Computer Science. She is currently working as Lecturer at College of Computing & Information Science – CoCIS, Pakistan Air Force - Karachi Institute of Economics and Technology. She has been working as academia for about 6 years and has researched different domains from CS. Her research interest include interaction Design, Information Systems, Enterprise Integration.

Samia Masood Awan completed Master of Engineering in Computers and Information Systems with specialization in Computer Networks and Performance Evaluation from NED University of Engineering and Technology (2014). She is currently working as a Research Assistant at Department of Computer Science – UBIT, University of Karachi. Her technical fields today are Computer Networks, Network Security and IoT.

Yusra Khalid She has completed her MS in Computer Science and Information Technology (2017). She is currently working as Teaching Assistant in Department of Computer Science - UBIT. Her main research interests are Human Computer Interaction, Computer Networking and Cloud Computing.