Extended E-CARGO Model in Real Distributed Environment

Sumi Saxena, Er. Anil Pandey

Abstract- A system which is object based and collaborative in nature allows users to know and fulfill their duties while concerning the powers and functions of other users in collaboration. Interfaces which help in defining roles, playing roles, interfaces managing class and object, interfaces supporting transition of roles, interfaces supporting negotiation of roles are needed in distributed platform. Analysis of a system is a typical task, but by using extended E-CARGO approach it can be made easier. In distributed system, when we assign the roles the complexity of the system can be reduced and conflicts are resolved. The obligations of research are proposing a generalized process of role-based collaboration in distributed system by mathematical equations.

***Keywords*- Collaboration, E-CARGO Model, Role conflict and Role Strain.**

I.INTRODUCTION

Role theory is a perspective in sociology and social psychology that considers most of everyday activity to be the acting out of socially defined categories (e.g. mother, manager and teacher). Each role is a set of rights, duties, expectations, norms and behaviour is context specific, based on social position and other factors. The theatre is a metaphor often used to describe role theory.

Depending on general perspective of the theoretical tradition, there are many types of role theory. The theory posits the following propositions about behaviour-

1. The division of labour in society takes the form of the interaction among heterogeneous specialized positions that we call role.
2. Roles included “appropriate” and “permitted” forms of behaviour, guided by social norms, which are commonly known and hence determine expectations.
3. Roles are occupied by individuals, who are called “actors”.
4. When individuals approve of a role (i.e. they consider the role “legitimate” and “constructive”), they will incur costs to punish those who violate role norms.
5. The anticipation of rewards and punishments, e satisfaction of behaving in a prosocial way [4], account for why agents conform to role requirements.

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Role based approach introduces a programming environment and architecture for the development of agent based cooperative applications. Cooperation process describes all and only the coordination and cooperation parts of an application. The cooperative behaviour of an agent is a separate role description. The interconnection of these roles constitutes the cooperation process. ROPE framework shows how agents decide what roles to accept and how the agent-role interaction works [1] .The association between different types of roles are limited by rules that govern the construction of a role hierarchy. The association of roles with roles to form a role hierarchy is responsible for much of the powerful features of RBAC .[11] Dynamic role allocation, provides a requirement analysis for dynamic role allocation , suggests a design for support in dynamic role allocation using object-oriented methodology and discusses the implemented and evaluated prototype .[4]

Developing and deploying a pervasive space is a multi-disciplined process where knowledge from various domains intersects. Several pervasive systems discusses a collaboration model that allows multiple roles , working together , to design , develop and maintain pervasive systems in physical spaces such as homes and buildings.[10] An ontology enabled runtime infrastructure support federation collaboration ontology usage in federated integration Systems[9]. Access control in a distributed system with external users and various organizations is an important issue in systems security [8].

A role based model specifies coordination and dynamic security requirements in collaboration systems. It also supports hierarchical structuring of a large collaboration environment using the concept for activities, which define a naming scope and a protection domain to specify security and coordination policies [7].

In terms of differences among role theory, on one side there is a more functional perspective, which can be contrasted with the more micro level approach of the symbolic integrationist tradition. This type of role theory dictates how closely related individuals’ actions are to the society, as well as how imperially testable a particular role theory perspective may be. A key insight of this theory is that role conflict occurs when a person is expected to simultaneously act out multiple roles that carry contradictory expectations.

Substantial debate exists in the field over the meaning of the "role" in role theory. A role can be defined as a social position, behavior associated with a social position, or a typical behavior. Some theorists have put forward the idea that roles are essentially expectations about how an individual ought to behave in a given position .Others have suggested that a role is a characteristic behavior, a part to be played. Role behaviour is influenced by following aspects-

1. The norms, determining a social situation.
2. External and internal expectations are connected to a social role.
3. Social sanction and rewards are used to influence role behaviour.

II. ROLE CONFLICT or STRAIN.

Role conflict is a conflict among the roles corresponding to two or more statuses.

Role strain or role pressure may arise when there is a conflict in the demands of roles, when an individual does not agree with the assessment of others concerning his or her performance in his or her role, or from accepting roles that are beyond an individual's capacity.

At the same time, a person may have limited power to negotiate away from accepting roles that cause strain.

III. COLLABORATION

Role based collaboration is an approach that can be used to integrate theory of roles into (CSCW) systems and other computer base systems. It consists of a set of concepts, principles, mechanisms and methods. Role based collaboration (RBC) presents challenges and benefits not found in traditional CSCW systems. This research will bring exciting improvements to the developments and application of CSCW systems and methodologies of collaboration

Even though we proposed RBC from the point of view of CSCW, we could expand RBC to more fields. RBC can be divided into two categories.

To perform better system analysis, design,
Implementation, application and evaluations, role theory is applied to CSCW or human computer interaction System. Therefore the gap can be bridged between their developers and sociologists who are more concerned with the usability of CSCW systems. General RBC is to extend special RBC to the areas such as software engineering, social psychology, organization management and artificial intelligence. General RBC considers not only supporting cooperation among people with computers but also that among the components of a system and between people and machines.

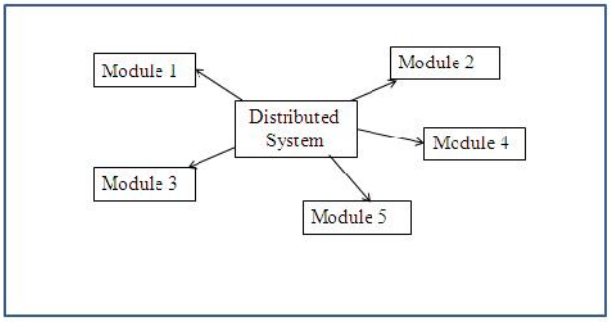

Fig-1 Distributed System

IV. E-CARGO MODEL

E-CARGO means Environment, Classes, Agents, Roles, Groups, and Objects. A system Ω can be described as a 9 tuple. $\sum::=\{C,O,A,M,R,E,G,s_0,H\}$ where

C is a set of classes
O is a set of objects
A is a set of agents
M is a set of messages
R is a set of roles
G is a set of groups
S_0 is the initial state of a collaborative system
H is a set of users

The initial state s_0 is expressed by initial values of all the components C,O,A,M,R and E , such as built in classes , initial objects , initial agents , primitive roles , primitive messages and primitive environments. With the participation of users H, such as logging into a collaborative system $\sum$, accessing objects of the system , sending messages through roles, forming groups in environments, $\sum$ evolves, develops and functions. The results of collaboration are a new state of $\sum$ that is expressed by the values of C, O, A, M, R, E, G and H. We include H to express that users might be affected by collaboration. Please note that without the participation of users, the system can only do what the agents can do. That is why users are an essential part of a system. [5]

Object and Class- Everything in this world is an object and every object has a class.

Agent- An agent is an entity consisting of a set of provided services. An agent is a special object that represents a user in collaboration. It is created when a new user signs up to the system. The necessity of agent is that when a user does not log in, the agent could accept incoming messages and send out simply reply messages.

Message- Interaction is a necessary entity for collaboration. To facilitate interaction among roles, messages are used.

Role- A role can show the specialties of some users. It provides them with message patterns not only to serve

others but also to access objects, classes, groups, and other roles.

Environment- People collaborate in an environment. People normally build groups in an environment. We can mimic a play on a stage. The stage is an environment

Group- Users work in a group and hold roles. Every work setting involves groups of individuals. In a group to accomplish a task, the group members interact with each other. We can define a group as a set of agents representing users playing roles in an environment.

Users- To model a computer-based system, we cannot directly encompass people in it. Therefore in this model, agents are representatives of people or users.

System- $\sum$=(C, O, A, M, R, E, G, s_o, H)

V.EXTENDED E-CARGO MODEL

Role theory is used to minimize conflict and reduce strain. Burden is reduced by giving assistance to an individual by his group members to enhance his performance. A role based collaborative system allows an individual to perform his compulsory duties. This model fulfills the requirements for role-based collaboration. A well defined formal model is proposed to define and mention a role. An architecture supporting implementation of role based collaboration [8].

By extended E-CARGO we mean Interfaces, Environment, Classes, Agents, Roles, Groups, and Objects. A system Ω can be described as 10 tuple. Ω::={I,C,O,A,M,R,E,G,s_0,H} where

I is a set of interfaces

$I=\sum$ (i=1 to n) (I_C|||I_R|||I_P|||I_N|||I_T)

I represent the Interfaces used in the collaboration. Definite interface is used for well defined purpose. The user has the authority to select only one of the interfaces at one time. The set of interfaces include interfaces such as interfaces managing class and object I_C, interfaces specifying role I_R , interfaces supporting playing of roles I_P , interfaces supporting negotiation of roles I_N, interfaces supporting transition of roles I_T. As a user tries to enter a collaborative system Ω then it selects user interface which is appropriate to him according to the type of role. Users collaborate and objects of the system are accessed by sending messages through roles. As a result groups are formed. The final outcome of a collaborative activity forms a new state of Ω that is defined by I, C, O, A, M, R, G and H. The new state of the system is S_1. By this collaborative activity users are also affected. When the users participate then only the system can do what agents perform.

The user interactions with system are supported by following interfaces:

Class and object management interfaces;

Role specification interfaces;

Role playing interfaces;

Role negotiation interfaces;

Role transition interfaces;

These interfaces provide framework to facilitate interactions with the system. Through a mechanism that specifies role and assists collaborative role based activity.

We have to define an environment and assign roles and then users play their roles. Users work in a group by playing a role otherwise not. They also bear some responsibility. When a user is not satisfied by his current role he can switch over to another role. When a user wants to exit a system then the agent representing that particular user will replace that user to accept messages. User's functions in the collaboration are as follows:

- An agent class is created that provide a facility to access objects, send outgoing messages and reply to incoming messages.
- Users negotiate to specify roles relevant to collaboration with the role facilitator and negotiators.
- Editing the methods of an agent class by adding, deleting and modifying and having the agents play roles.
- Roles are played by user.

MATHEMATICAL EXPRESSIONS

Consider R1, R2 and R3 are sets of roles

1. .R1 U R1= R1

2. R1 ∩ R1=R1 are called Idempotent laws.

3. R1 U R2=R2 U R1

4. R1 ∩ R2=R2 ∩ R1 are called commutative laws.

5. (R1 U R2) U R3=R1 U (R2 U R3)

6. (R1 ∩ R2**)** ∩ R3=R1 ∩ (R2 ∩ R3) are called Associative laws.

7. R1 U (R2 ∩ R3) = (R1 U R2) ∩ (R1 U R3)

8. R1 ∩ (R2 U R3) = (R1 ∩ R2) U (R1 ∩ R3) are called Distributive laws.

Let R1 and R2 are sets. Cartesian product of A & B, denoted by R1 X R2, is defined as

R1 × R2= {(r1, r2): r1∈R1 and r2∈R2}

Such that R1 X R2 is the set of all possible ordered pairs whose first component comes from A and

Whose second component comes from B.

9. $(R1 \cap R2) \times (R3 \times R4) = (R1 \times R3) \cap (R2 \times R4)$

10. $(R1 \cup R2) \times R3 = (R1 \times R3) \cup (R2 \times R3)$

11. $R1 \times (R2 \cap R3) = (R1 \times R2) \cap (R1 \times R3)$

Proof-

1. R1UR1=R1

Let x be an arbitrary element of the set R1,
Then x∈R1
= x ∈R1 or x∈R1
= x ∈ (R1UR1)
Thus, R1⊆ (R1UR1) - (1)
Conversely, if x ∈ (R1UR1), then x∈R1 or x∈R1
Hence (R1UR1) ⊆ R1 - (2)
From (1) and (2)
R1UR1=R1

2. R1∩R1=R1

Let x be any arbitrary element of the set R1,
Then x∈R1
=x∈R1 and x∈R1
=x∈ (R1∩R1)
Thus, R1⊆ (R1∩R1) - (1)
Conversely, if x∈ (R1∩R1), then x∈R1 or x∈R1
Hence (R1∩R1) ⊆ R1 - (2)
From (1) and (2)
R1∩ R1=R1

3. R1UR2=R2UR1

Let x be any arbitrary element of the set R1UR2,
Then x∈R1UR2
=x∈R1 or x∈R2
=x∈R2 or x∈R1
=x∈ R2UR1
Thus, R1UR2 ⊆ R2UR1 - (1)
Conversely let x be any arbitrary element of the set R2UR1,
Then x∈R2UR1
=x∈R2 or x∈R1
=x∈R1 or x∈R2
=x∈ R1UR2
Thus, R2UR1 ⊆ R1UR2 - (2)
From (1) and (2)
R1UR2=R2UR1

4. R1∩R2=R2∩R1

Let x be any arbitrary element of the set R1∩R2,
Then x∈R1∩R2
=x∈R1 and x∈R2
=x∈R2 and x∈R1
=x∈ R2∩R1
Thus, R1∩R2 ⊆ R2∩R1 - (1)
Conversely let x be any arbitrary element of the set R2∩R1,
Then x∈R2∩R1
=x∈R2 and x∈R1
=x∈R1 and x∈R2
=x∈ R1∩R2
Thus, R2∩R1 ⊆ R1∩R2 - (2)
From (1) and (2)
R1∩R2=R2∩R1

5. (R1UR2) UR3=R1U (R2UR3)

Let x be any arbitrary element of the set (R1UR2) UR3,
Then x∈ (R1UR2) U R3
=x∈ (R1UR2) or x∈R3
= (x∈R1 or x∈R2) or x∈R3
=x∈R1 or (x∈R2 or x∈R3)
Thus, (R1UR2) UR3 ⊆ R1U (R2UR3) - (1)
Conversely let x be any arbitrary element of the set
R1U (R2UR3),
Then x∈ R1U (R2UR3)
=x∈R1 or x∈ (R2UR3)
=x∈R1 or (x∈R2 or x∈R3)
=x∈R1 or (x∈R2 or x∈R3)
Thus, R1U (R2UR3) ⊆ (R1UR2) U R3 - (2)
From (1) and (2)
(R1UR2)UR3=R1U (R2UR3)

6. (R1∩R2) ∩R3=R1∩ (R2∩R3)

Let x be any arbitrary element of the set (R1∩R2) ∩R3,
Then x∈ (R1∩R2) ∩ R3
=x∈ (R1∩R2) and x∈R3
= (x∈R1 and x∈R2) and x∈R3
=x∈R1 and (x∈R2 and x∈R3)
Thus, (R1∩R2) ∩R3 ⊆ R1∩ (R2∩R3) - (1)
Conversely let x be any arbitrary element of the set
R1∩ (R2∩R3),
Then x∈ R1∩ (R2∩R3)
=x∈R1 and x∈ (R2∩R3)
=x∈R1and (x∈R2 and x∈R3)
=x∈R1 and (x∈R2 and x∈R3)
Thus, R1∩ (R2∩R3) ⊆ (R1∩R2) ∩ R3 - (2)
From (1) and (2)
(R1∩R2) ∩R3=R1∩ (R2∩R3)

7. R1U (R2∩R3) = (R1UR2) ∩ (R1UR3)

Let x be any arbitrary element of set R1U (R2∩R3),
Then x∈R1U (R2∩R3)
=x∈R1 or x∈ (R2∩R3)
=x∈R1 or (x∈R2 and x∈R3)
= (x∈R1 or x∈R2) and (x∈R1 or x∈R3)
=x∈ (R1UR2) ∩ (R1UR3)
Thus R1U (R2∩R3) ⊆ (R1UR2) U (R1UR3) - (1)
Conversely, let x be any arbitrary element of the set
(R1UR2) ∩ (R1UR3),

Then x∈ (R1UR2) ∩ (R1UR3)
=x∈ (R1UR2) and x∈ (R1UR3)
= (x∈R1 or x∈R2) and (x∈R1 or x∈R3)
=x∈R1 or (x∈R2 and x∈R3)
=x∈ R1U (R2∩R3)
Or (R1UR2) ∩ (R1UR3) ⊆ R1U (R2∩R3) - (2)
From (1) and (2)
R1U (R2∩R3) = (R1UR2) ∩ (R1UR3)

8. R1∩ (R2UR3) = (R1∩R2) U (R1∩R3)
Let x be any arbitrary element of set R1∩ (R2UR3),
Then x∈R1∩ (R2UR3)
=x∈R1 and x∈ (R2UR3)
=x∈R1 and (x∈R2 or x∈R3)
= (x∈R1 and x∈R2) or (x∈R1 and x∈R3)
=x∈ (R1∩R2) U (R1∩R3)
Thus R1∩ (R2UR3) ⊆ (R1∩R2) U (R1∩R3) - (1)
Conversely, let x be any arbitrary element of the set (R1∩R2) U (R1∩R3),
Then x∈ (R1∩R2) U (R1∩R3)
=x∈ (R1∩R2) or x∈ (R1∩R3)
= (x∈R1 and x∈R2) or (x∈R1 and x∈R3)
=x∈R1 and (x∈R2 or x∈R3)
=x∈ R1∩ (R2UR3)
Or (R1∩R2) U (R1∩R3) ⊆ R1∩ (R2UR3) - (2)
From (1) and (2)
R1∩ (R2UR3) = (R1∩R2) U (R1∩R3)

9. (R1∩ R2) × (R3∩R4) = (R1×R3) ∩ (R2×R4)

Let (x, y) be any element of (R1∩ R2) × (R3∩R4).
Then (x, y) ∈ (R1∩ R2) × (R3∩R4)
=x ∈ (R1∩R2) and y ∈ (R3∩R4)
= (x∈R1 and x∈R2) and (y∈R3 and y∈R4)
= (x∈R1 and y∈R3) and (x∈R2 and y∈R4)
=(x, y) ∈ (R1×R3) and (x, y) ∈ (R2×R4)
=(x, y) ∈ (R1×R3) ∩ (R2×R4)
(R1∩ R2)× (R3∩R4) ⊆ (R1×R3) ∩ (R2×R4) - (1)

Conversely Let (x, y) be any element of the set

(R1×R3) ∩ (R2×R4)

Then (x, y) ∈ (R1×R3) ∩ (R2×R4)

=x ∈ (R1×R3) ∩ (x, y) ∈ (R2×R4)

=x ∈ (R1×R3) and y ∈ (R2×R4)

= (x∈ R1 and y ∈R2) and (x∈R3 and y ∈R4)

=(x, y) ∈ (R1×R2) and (x, y) ∈ (R3×R4)
=(x, y) ∈ (R1×R2) ∩ (R3×R4)
(R1×R3) ∩ (R2×R4) ⊆ (R1×R2) ∩ (R3×R4) - (2)
From (1) and (2)
(R1∩ R2) × (R3∩R4) = (R1×R3) ∩ (R2×R4)

10. (R1 U R2) × R3 = (R1×R3) U (R2×R3)

Let (x, y) be an element of (R1 U R2) ×R3

Then x ∈ (R1UR2) and y ∈R3

=(x ∈R1 or x ∈R2) and y ∈R3

=(x ∈R1 and y ∈R3) or (x ∈R2 and y ∈R3)

=(x, y) ∈ (R1×R3) or (x, y) ∈ (R2×R3)

=(x, y) ∈ (R1×R3) U (R2×R3)

(R1 U R2)×R3 ⊆ (R1×R3) U (R2×R3) - (1)

Conversely, let x be any arbitrary element of the set (R1×R3) U (R2×R3), then

=(x, y) ∈ (R1×R3) U (R2×R3)

=(x, y) ∈ (R1×R3) or (x, y) ∈ (R2×R3)

=(x ∈R1 and y ∈R3) or (x ∈ R2 and y ∈R3)

=(x ∈R1 or x∈R2) and y∈R3

=(x ∈R1UR2) and y ∈R3

=(x,y) ∈ (R1UR2) ×R3

(R1×R3)U (R2×R3) ⊆ (R1UR2) ×R3 - (2)
From (1) and (2)
(R1 U R2)×R3= (R1×R3) U (R2×R3)

11. R1× (R2∩R3) = (R1×R2) ∩ (R1×R3)

Let (x, y) be any element of R1× (R2∩R3),

Then (x, y) ∈ R1× (R2∩R3)

=x ∈R1 and y ∈ (R2∩R3)

=x ∈R1 and (y∈R2 and y∈R3)

= (x∈R1 and y∈R2) and (x∈R1 and y∈R3)

=(x, y) ∈ (R1×R2) and (x,y) ∈ (R1×R3)

=(x, y) ∈ (R1×R2) ∩ (R1×R3)

R1× (R2∩R3) ⊆ (R1×R2) ∩ (R1×R3) - (1)

Conversely Let (x, y) be any element of the set

(R1×R2)∩ (R1×R3)

Then (x, y) ∈ (R1×R2) ∩ (R1×R3)

=(x, y) Є (R1×R2) and (R1×R3)

= (x Є R1 and y ЄR2) and (x ЄR1 and y ЄR3)

=x Є R1 and (y ЄR2 and y ЄR3)

=(x, y) Є R1× (R2∩R3)

(R1×R2) ∩ (R1×R3) ⊆ R1× (R2∩R3) - (2)

From (1) and (2)

(R1×R2) ∩ (R1×R3) = R1 × (R2∩R3)

VI. SENARIO HOSPITAL MANAGEMENT SYSTEM

- ☐ Patient registration
- ☐ Appointments scheduling
- ☐ Billing and payments (cash, CC, insurance)
- ☐ Security of the whole system
- ☐ Pharmaceutical drugs/equipment
- ☐ Staff management (work roster, availability, scheduling, etc)
- ☐ Management functions (report generation, accounting, etc)
- ☐ System administration
- ☐ Resource allocation (booking rooms, operating theatres, etc)
- ☐ Comprehensive database

We have proposed extended E-CARGO model. Hospital Management System is represented on Rational Rose Software. We have seen that patient is a person who is allotted an ID; he has a name and phone number. He interacts with Admin staff, Department, Operation staff and makes payment.

Class diagram representing scenario of hospital management is shown in figure 3. The class diagram shows classes and interfaces, attributes, operations, of respective class. It also shows association and generalization relationship among classes.

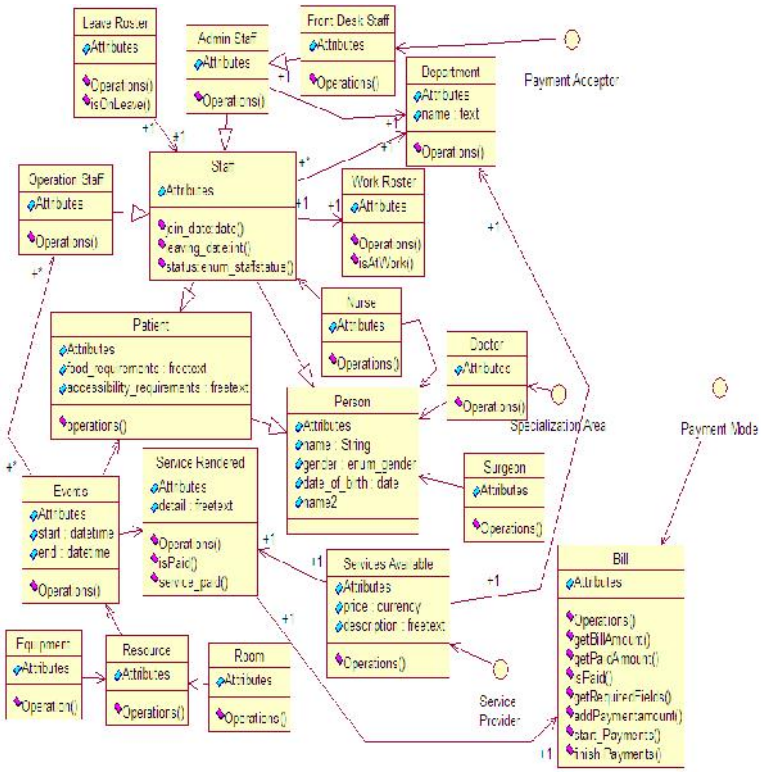

Fig-2 Class Diagram representing Patient's accounting in Rational Rose Platform

Table representing different roles, interfaces, role responsibility, attributes, group and environment described in the class diagram in fig. 3 is shown in table 1.

Role	Interface	Role Responsibility	Attributes	Group	Environment
Patient	Person	Provide insurance details, deposit is required when patient do not have insurance details, seeks consultation	Name ,gender, Date _of_ birth	Service Seeker	Hospital
Surgeon	Specialization Area	Surgery	Name , ID, Department	Operation Staff	Hospital
Nurse	Duties Assigned	Medication, servicing, nursing	Name , ID, Department	Treatment providing Staff	Hospital
Doctor	Department	Provides consultation, Diagnosis, Prescription	Name , ID, Department	Treatment providing Staff	Hospital
Admin Staff	Staff	Record keeping, Administration, Computer operating skills	Name , ID	Hospital Staff	Hospital
Front Desk Staff	Payment Acceptor	Payment Receiving	Name , ID	Hospital Staff	Hospital
Bill	Payment Mode	Giving payments	getBillAmount, getPaidAmount, isPaid	Payment	Hospital
Resource	Service Provided	Room provider, Equipment provider	Room no., equipment information	Services Rendered	Hospital

Table-1 Role Collaboration in Hospital Management System

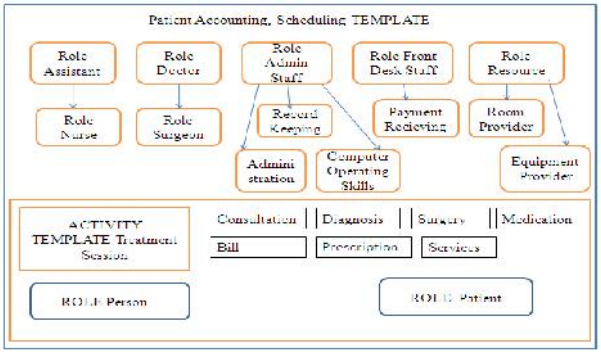

Fig-3 Template representing Patient's Accounting & Scheduling

The scenario of hospital management has been described by the template representing patient's accounting and scheduling described in fig. 3. The Coordination among different roles of hospital is described. Different activities performed in hospital are shown in fig – 4.

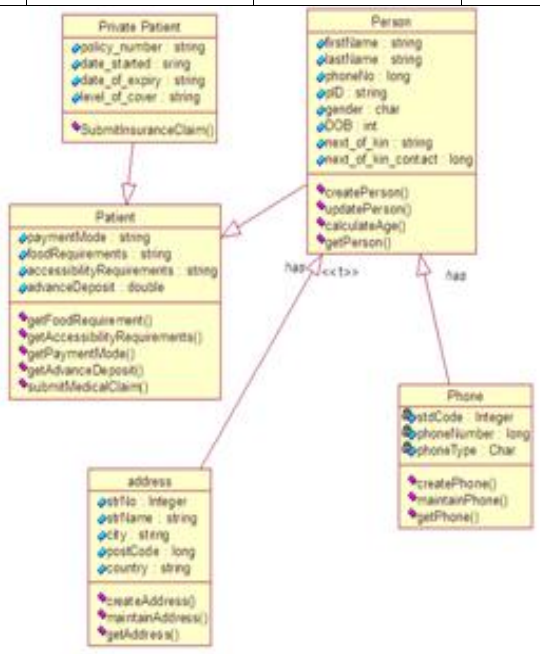

Fig-4 Class Diagram representing Patient Details in Rational Rose Platform

VII. CONCLUSION

We have proved role-based collaboration in distributed system by mathematical equations. We have described a formal model Extended E-CARGO that supports the basic

issues of role-based collaboration. Description of E-Cargo model on Hospital management is given.

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