n-Layer Platform for Hi-Tech World

R. B. Patel, Lalit Awasthi, M. C. Govil, and Rachita

1 Introduction

The online information management systems are in demand of today's world for easing the life of human beings. The growth for demand of services becomes populous because of increasing use of the Internet. If every citizen of a national is fond of to use technology to fulfill day-to-day needs, then the traffic/network bandwidth will be the crucial for a nation. Democratic increasing participation, accountability, transparency, quality of service, and on time availability of services are challenges for a country [14]. An e-governance system, which caters such type of functions, are partially available in few developed countries [1, 2, 3, viz., Europe, the United States, Australia, and Singapore, etc.]. A complete e-governance system is demand of present generation as on date it is not fully functional in any country around the world. An intelligent e-governance system may be adapted/implemented worldwide by next decade [7, 8]. At present, it will be early to say that e-governance system is available across the world. It gives knowledge to the citizen about the day-

Note: We have used model, platform, and framework interchangeably.

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to-day development of a country. But due to limitation of client/server technology, this system suffers in terms of network bandwidth when number of client increases. The next decade world will be challenging for system managers to fulfill the desire of human beings, result force to create hi-tech world. This development in the mind of people demand a system, which should fulfill requirement of the people, and also it should adapt the new changes/developments. Thus, it is required to model such a system in which every country should be a member of it and work over a common platform in global public interest [9, 10].

A work agent (WA) is a mobile software program, i.e., mobile agent (MA), which moves from nodes to nodes over the global network. It searches for the required resources to accomplish the assigned task to it. When it finds resources, it finishes the assigned task and returns the outcome of the task to its owner and issues death warrant to itself and dies. Death warrant is important to avoid the misuse of code and associated data with a WA. This article presents a novel n-layer platform for hi-tech world. In this platform, agent technology is used. A new and unique naming scheme is used to identify citizen of a country and unique name to the work agent(s) created by its owner. The initial part of this naming scheme provides unique identification to citizen of a country, which is the owner of the agent(s). It provides a unique name for an agent across the global network for everyone using mobile agent technology (MAT). In the proposed platform, value of n may vary from 2 to 10. We have considered India as a case study, and in this platform, n is considered as 7 plus 1. Here, 7 is used to uniquely define identification for every citizen and eighth level to give identification to work agent(s) created by a citizen.

This platform is named as neighbor assister framework for mobile agents (NAFMA). Here, mobile agent is interchangeably used for physical mobile agent(s). It may be a citizen of a country. This scheme uses an eight-component-based naming scheme for MAs. In this naming scheme, seven components are arranged in logical hierarchical order. The seven components of the name are contributed by seven layers of the NAFMA and eighth component is contributed by the agent owner itself. Every layer of the NAFMA is integrated with platform for mobile agent distribution and execution (PMADE) [2, 12]. In NAFMA, each layer is integrated with layer intelligent agents (LIAs). This system uses hexadecimal digital identification code for every citizen of a country. The length of code is 17-digit for citizen and 18th digit for defining a WA. NAFMA supports two types of services, internal and external. These services are being useful for the day-to-day work of the persons belonging to a country. External services serve everyone around the world. These are available at country layer of the said system. Thus, system tells one world, one umbrella. There are several other types of services, which are required to be available among the people of a country and are managed by provincial layers, which are known as internal services.

Implementation of this system will bring the whole world under one umbrella and make hi-tech world smart and green. This system will also remove the hurdles of carrying documents while traveling across the world. Only using the NAFMA card and finger/face print details can be fetched from the system, which in result will present identification of an individual along with face value.

This system assigns unique 17-digit identification (ID) code to every citizen and 1-digit ID to their work agent(s), which means that a citizen will be permitted to use 16 work agents concurrently. This system uses the peer-to-peer concept to generate location-dependent identification code for the citizens [2, 4]. Citizens are permitted to share their views and ideas with other citizen and authorities as well as with the government with the help of work agents across the globe. This system will support all kind of applications related to human beings. In the development of this system, we have used a model, platform, and framework interchangeably.

Rest of the article is organized as follows: Section 1 discusses the Introduction, and Sect. 2 presents information management issues and challenges. Discussion about Indian administrative system is given in Sect. 3. System model is explored in Sect. 4, and system architecture is given in Sect. 5. Unique costumer identification code is presented in Sect. 6. Implementation and performance study is given in Sect. 7. Discussion about findings is explored in Sect. 8, and finally, this chapter is concluded in Sect. 9.

2 Information Management Issues

Easily availability of Internet connectivity fuelled the growth of electronic information. This happened due to the advancement of electronic system. The growth of advancement in electronic system promoted production of economical electronic gadgets and their usages. Because of these, cheap/economical use of Internet services grows drastically around the world. These usages of the Internet services are considerably worsening information management challenges. These information management challenges are prodigious issues for the organizations and governments because of their dependencies on existing rules and resources. Organizations and governments are suffering because of no clear direction for the use of technologies and their integration with disparate information management systems available with them. Policies of organizations and governments are also suffering from internal politics and non-clarity around broader organizational strategies and directions. Thus, information management system suffers from poor quality of information, which leads to inconsistency, duplicate, and stale information. Further, most important factor in changing working practices and processes of staff of the organizations is that it does not want to go for upgradation as per need of demand of time. To handle such issues, researchers proposed several models.

Authors [5] explored the opportunities and challenges for the organizations, which were networked. They presented a flexible and efficient information architecture for establishing new values, attitudes, and behaviors to share information and build databases. This system provides integrated customer support on a worldwide basis and protects personal freedoms and privacy.

Electronic brainstorming is seemingly suitable and prevalent platform in the twenty-first century. It makes daily public life easy but leaves the issues behind its management and security [6].

The Unique Identification Authority of India (UIDAI) is mandated to issue an easily verifiable 12-digit random number as unique identification for its residents. The UIDAI issued 12-digit unique identification (UID) number (termed "Aadhaar"). In Aadhar card number, twelfth digits are used for checksum [13]. There are several limitations with this UID. It does not guide straight way about the location/place of actual birth of a person who is using it. This card does not provide day-to-day wealth condition of individuals. One card with all kind of tasks (banking, income tax, vehicle registration, driving license, loan account management, payment, etc.) is not possible with UID. Aadhar card also does not warrant food guaranty to everyone every day. It does not keep records of unemployed citizens of India.

Besides, there several other issues which are not addressing real life of human beings of most developing and under developing countries. Poverty is a major issue amongst underdeveloped/developing countries, where the system is not able to reach in time to the common people, resulting in growth of younger generation being hampered due to lack of basic necessities. Thus, there is a need of a common e-governance system, which should address the issues of common people with reduced management cost of overall system of a country [10, 11].

3 Indian Administrative System

When the population and area of a system becomes very large, the cost and processing involved in directed communication are prohibitive. A popular alternative to direct communication that eliminates these difficulties is to organize the population and area into a federated system. Citizens of a country do not directly communicate with the higher authority, but locally, they can communicate. A set of people/area has a facilitator, who kept informed about their individual needs and abilities. Citizens/individuals can also send and receive application-level information and requests to these facilitators. Facilitators use the information provided by citizens/individuals to transform these application-level messages and route them to appropriate authorities. A federated system consisting of a group of organizations, countries, regions, etc. have joined together to form a larger organization or government.

India is a federated republic, with a civil law system. It consists of 29 states and eight union territories. There are 638 districts in states, 11 districts in Delhi, and 26 districts in union territories. Further, these districts are organized in Tehsil/block/Taluka, which are about 5479 in the states +269 in Delhi and union territories. India at route level divided into villages and wards. There are approximate 638,365 villages and wards across the country.

The system proposed in Fig. 1 faces several issues, viz., observation about common people is not possible in time, observation of the higher authority by lower precedence (common) people is not possible, what schemes are for the individual's welfare never reach in time to everyone, higher authority always being dependent on their subordinates for getting the status of the common people, current election

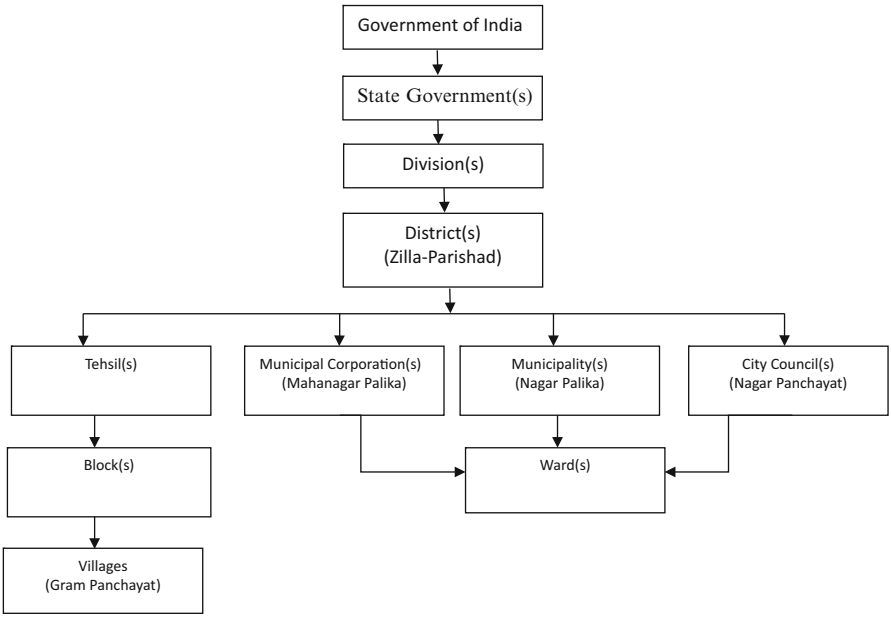

Fig. 1 Administrative organization of India at a glance

system of India utilizes 20–30% of the budget of a complete year, and how the common people earning will be saved and utilized for the society.

4 System Model

The proposed hi-tech world model is n-Layer Platform, which uses agent technology in background. In this model, a new and unique naming/identification scheme is used to identify citizen of a country and to provide unique name to the citizen's work agent(s). This naming scheme is composed of two parts. The first part is composed of seven layers of this naming scheme, which provides unique identification to citizen of a country who are entitled to create their work agent(s). The eighth layer shows how many work agents a citizen allowed to create. The proposed system promises a unique identification to every citizen of a country and name for every work agent within the global network for everyone using agent technology. In the proposed platform, value of n may vary from 2 to 10. We have considered India as a case study, and in this, platform n is considered as 7 plus 1. Here, seven is used to uniquely define identification for every citizen and eighth level to give identification to work agent(s) created by a citizen.

The seven-coordinating layers are arranged logically in a hierarchical fashion. Seven components of the name/identification are contributed by seven layers of

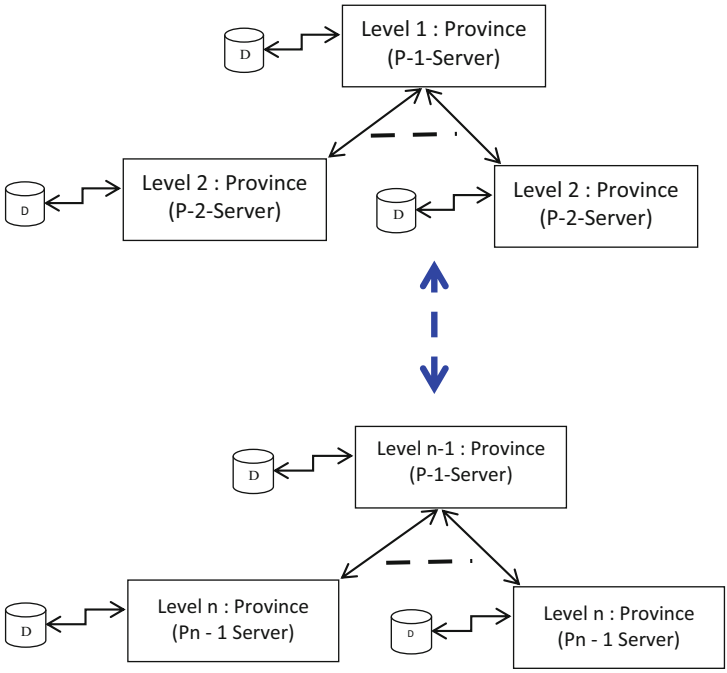

Fig. 2 n-Layer neighbor-assisted framework for mobile agents (NAFMA)

the said system, and eighth components is contributed by the agent owner/citizen itself. This new agent naming/identification scheme will give base to develop hi-tech world as shown in Fig. 2. The coordination among the layers is an important factor for smooth functioning of the system. Further, NAFMAs of different countries' coordination will be a major factor for the completion of the task of a work agent and of a citizen who is a resident of a country.

The proposed system (NAFMAS) accepts the information through registration process. But it also opens channel to accept other format databases. Anyone who wants to become member of this system may register by giving his/her details with valid credentials and documents. Database created through registration process or through integration of databases of other system is partially shared by this system among its layers [2, 7]. It also accepts the Aadhar card database of India for gathering the information about its citizens. This system converts 12-digit decimal numbers into a 17-digit (Hex digit) unique identification for a citizen. A person who registers with this system has the right to decide one-nibble identification code range to his/her work agent. In general purpose, a work agent may be a vehicle, a house, an income tax identification, a passport, a field of land, etc. A registered member with NAFMAS system allowed for both types of services to fulfill day-to-day work. The deployment of NAFMAS e-governance system will allow/permit the services, namely the Internet, E-taxation, E-health schemes, E-education, social

service, and E-conversation with the persons of other countries. It will also facilitate events, which are based on resource, time, and money constraints, viz., E-voting, E-democracy, and E- suggestions [14].

NAFMA database is useful for all kind of systems who are focused to work through e-governance. One such example is international law, which is required to be formed for using the database of the said system. By implementation of international law, international police may use this database for identifying the persons/systems, who/which are doing illegal work(s). When an organization/government wants to allocate project(s) to any person/organization, it is not required to collect the information for the same person. Simply by using the identification code of a person/organization, all details can be collected/verified before the allotment of project(s). Further, to mention that, this system may work like a ready-made database at every layer. A person is not required to keep identity proof; only NAFMAS card will be sufficient because every kind of identification marks, viz. snap, finger print, and retina of every person, are collected by the said system just once. This NAFMAS system keeps track of all kind of changes a person may possible make to do the crime. If changes are made by a person same, is reflected at every layer of the system.

5 System Architecture

We have developed a neighbor-assisted framework for mobile agent (NAFMA) based on e-governance system. It is a peer-to-peer n-layer architecture. These layers are logically hierarchical in nature. Scalability and communication efficiency is a major achievement of the proposed system. PMADE is background technology, and layer specific intelligent agents (LSIAs) are integrated at each layer. NAFMAS e-governance system uses one LSIA at each layer. Number of LSIAs depends on governance structure of a country that is going to be member of NAFMAS. If governance structure uses n-level federated system, then at list n-LSIA will be required to run the system smoothly.

We have considered the province of India as a case study. Figure 3 shows NAFMAS model for province of India. The top layer contains country intelligent agent(s) (CIA) and maintains external linkage with the world. It manages information about a country for it is serving like external affairs. It keeps information about the culture, gender wise population, source of income from agriculture and industry, area and category-developing/developed country, etc. Besides above said information, CIA running at P-1-Server keeps several attributes.

The state intelligent agent (SIA) keeps track of state information at the P2 Server, which is at layer 2. Similarly, P3 Server takes care of district intelligent agent (DIA), which lies at layer 3 and is district head quarter. It maintains information about the people of districts. Tehsil intelligent agent (TIA) keeps itself on P4 Server, which is in-charge of layer 4 and keeps records of public of a tehsil. Block intelligent agent (BIA) is being owner by P5 Server. It keeps records of citizens of a block

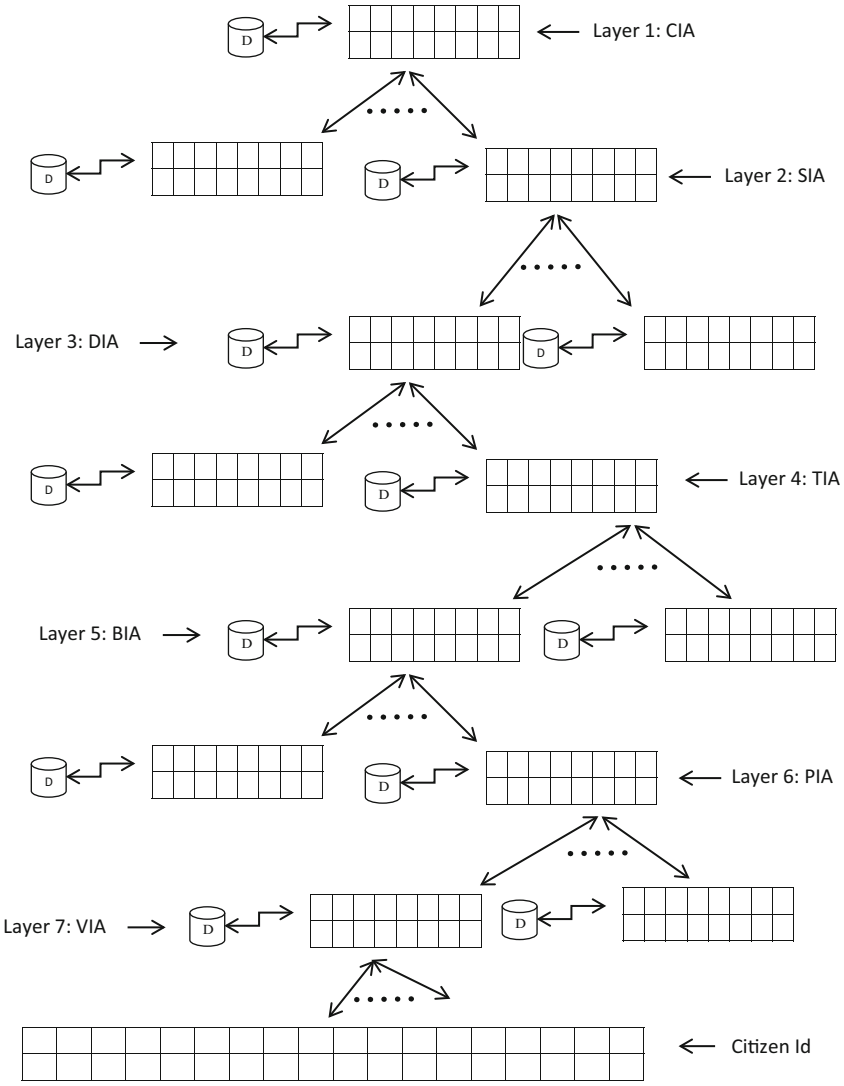

Fig. 3 Citizen ID and work agent generation using intelligent agents

at layer 5. P6 Server runs Panchayat/ward intelligent agent (PIA). It is the owner of layer 6 of the system. Bookkeeping about citizens of a Panchayat/ward is done by it. Layer 7 runs P7 Server for village/town. It uses smart and intelligent agent for keeping the records. Actual data maintained at this layer is being replicated across the different layers. Authenticity of records/data of citizens is important for a country. All above discussed agents decides about the unique identification number

of a citizen. A citizen is permitted to allocate 1-nibble ID to its work agent, which is the eighth layer of NAFMAS.

NAFMAS is an intelligent e-governance model, which maintains heterogeneous collection of databases. Accessibility of this database is only possible through NAFMAS members. This system maintains information specific agents (ISAs) for the help of users. An ISA handles user/client tasks with the help of system intelligent agents (SIAs.). Communication may takes place between ISA and SIA(s) for processing queries/exchanging information. System keeps track record of visiting work agent(s), ISA(s), SIA(s), and system resources access during the execution of assigned task(s). It is also required to make distinction between the task(s), information access agent (IAA), and other agent(s). An IAA is permitted to access the databases in read-only mode. This database may belong to government organization/department/private. Securities of the records are important at any stage, which is easily secured by NAFMAS system using the PMADE security features [15].

6 Unique Citizen Identification Code (UCIC)

The NAFMAS e-governance system ensures unique costumer identification code (UCIC) for every citizen of a country. It uses down-streamed concept for generating identification code (IDs) of different layers. This process is done at the system boot up time. Higher level layers are responsible to provide IDs toward lower order/level layers. A layer at lower level in the hierarchy is responsible for prefixing the main part of identification code to its own local ID. A combined approach of all the layers in the system contributes for the generation of new ID of a layer. The country being studied in this article is India (as a case study). At primary level, it is the land of villages and secondary level towns. The lowest (layer 7) will be at Province Level 7. A 17-hex digits identification code (Id) is issued by the said system to every person of a country. A citizen itself is permitted to allocate 1-nibble ID to its WA(s). Figure 4 illustrates sample identification code. This identification code consists of 2-nibble country provincial code, 2-nibble state provincial code, 2-nibble District provincial code, 1-nibble to represent tehsil provincial code, 1-nibble for block provincial code, 2-nibble for Panchayat provincial code,1-nibble for village/town provincial code, and 5-nibble for representing the citizen identification number (ID). In code, the first field is priority code, which is sued to represent one for developed country, two for developing country, any other number as per need and will be decided by international body. Here, 0 is used for no priority.

A nibble (4-bits of binary digits) is used to form a hexadecimal digit. So for simplicity data, size format nibble is used in the system. Sample format shown in Fig. 4 enables a total population of 1,048,576 in a village/town. Each citizen is allowed to launch simultaneous 16 work agents at 16 sites at a time. This system generates 2^{52} million unique user identification codes. Initially, a citizen is required to register himself/herself through local provinces. It may be done through

1	2	3	4	5	6	7	8	9	10	««Field No
Priority	CPC	SPC	DPC	TPC	BPC	PPC	VPC	Citizen Code	Agent Code	Source Of Data
1-16	1-256	1-256	1-156	1-16	1-16	1-256	1-16	1-1048576	1-16	Maximum Data Bits
0	5 B	0 B	0 5	2	8	0 1	5	0 0 0 1 C	4	Id in Hexadecimal
1-nibble	2-nibble	2-nibble	2-nibble	1-nibble	1-nibble	2-nibble	1-nibble	5-nibble	1-nibble	Size in Nibble

Fig. 4 Citizen ID generation fields using WA Province Level 7, Village/town(VPC); Province Level 6, Panchayat (PPC); Province Level 5, Block (BPC); Province Level 4, Tehsil (TPC); Province Level 3, Districts (DPC); Province Level 2, State (SPC); Province Level 1, Country (CPC)

a ward/village/town layer of the system. NAFMAS system appends citizen ID with the system ID for generating a unique identification code for a citizen. Figure 4 presents 2 (Priority-developing country), 5B (India), 0B (Delhi), 05 (West Delhi District), 2 (Punjabi Bagh, Tehsil), 8 (Nilothi block), 01 (Chander Vihar, Panchayat), 5 (Shani Bazar Town), 0001C (Dr. Munshi Yadav), and 4 (work agent) for Dr. Munshi Yadav's agent.

Dr. Yadav is a citizen of country India; Delhi State, West Delhi District; Punjabi Bagh, Tehsil; Nilothi block; Chander Vihar, Panchayat; and Shani Bazar Town. Here, 5B is a code of India, personal ID of Dr. Munshi Yadav is 0001C, and his work agent ID is 4. Other details are as discussed above.

This identification code is hierarchical in nature. Code is generated through upstream toward the root of tree and every component of the code passes through the branch(s) of the tree. This process reflects availability of identification to each of its parental ancestor layer. A WA moving across the global network possesses a unique identification code and permitted to make conversation to any ancestor layer through its local village/town layer agents. In case of failure, corruption, and maliciousness citizen, a work agent is permitted to directly approach to its next higher ancestor in the branch. A citizen work agent is not allowed to route through the branch to which it does not belong, because the identification of that citizen work agent will be supported only by branch to which it belongs. In case of roaming of the citizen work agent, the system may also be enhanced to provide all privileges, viz., create work agent assign to the work agent.

7 Implementation and Performance Study

Implementation of NAFMA-based e-governance system tested on the networks of 60 machines. These machines are divided into 40 networks. To implement all the state provinces, 38 networks are established, one for each state/union territory. Two state networks are completely implemented, and all layers are equipped with 1/2 machines. Each network has a gateway to work as a province server.

Remaining four machines are working as country servers for different countries. Every machine is equipped with PMADE secure mobile agent platform, and on the top of it, NAFMAS system is executed. Each machine possesses configure as follows: Intel(R), Core(TM), i7–8700, CPU @ 3.20GHz, 3.19 GHz, 8.00 GB RAM, 64-bit operating system, x64-based processor, and Windows 10 Pro. The arrival rates of WAs on different sites/servers are function of poison distribution. Further, to mention that, registration process of 1 million citizens is done randomly. System is also updated with some UDAI database. More than 5000 WAs were launched from different users/clients at different traffic load (high/peak and medium and low) on the network. These WAs allowed for working on different location of the network. In the implementation of the said system, different performance metrics were used, viz., fault tolerant, security, network delay, and failure of different layers. This system kept continuously running for few weeks in different conditions.

Performance measurement of NAFMA e-governance system depends on the various implementation factors. Case study implementation of said system inherently consists of eight layers. Country layer sits at first level and a citizen at eighth level. The network delay (ND) may occur in WA transportation. Movement of WA may be upward (from layer 8 to 1) or downward (from layer 1 to 8) in system. This movement takes time accordingly.

Per record registration time is 10 minutes for entering a fresh record into the database. In the implementation of said system, it is assumed that minimum number of record per village/town is 500 citizens, and maximum is 10,000. In city wards, population is more and is assumed that is in 5000 minimum and maximum 50,000, respectively. Record processing time (RPT) depends on the network traffic. Figure 5 shows time required for registration of all the citizens of country (India). It shows that if system will run, fault free about 100 days will be required to complete the registration process. When random network failure occurs, maximum registration time increases, and it is about 119 days. RPT also increases in maximum time in processing of records, which is 876 ms. But without failure, it is 776 ms.

In the implementation of the system, 500 minimum and 800,000 maximum numbers of queries were generated to study the processing time of the system. Figures 6 and 7 show the query processing time (QPT) with and without network failure. It is observed that network failure affects system performance but its effect is very less.

8 Discussion

NAFMAS-based e-governance system warrants food guaranty for every poor in the locality of every province. This system will realize duty of every public-elected official. The said system is fully distributed. One-time initial implementation cost of system will be about Rs. Six hundred cores for India, like huge country. UDAI

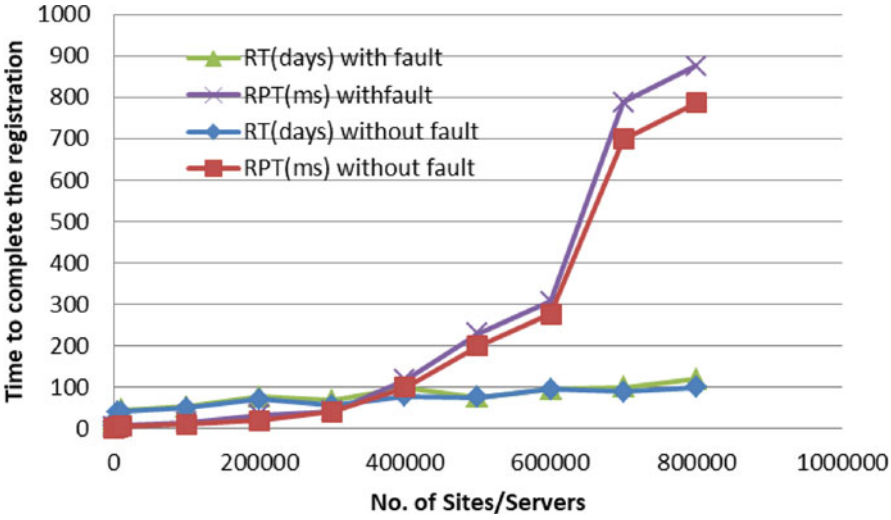

Fig. 5 Registration and record processing time

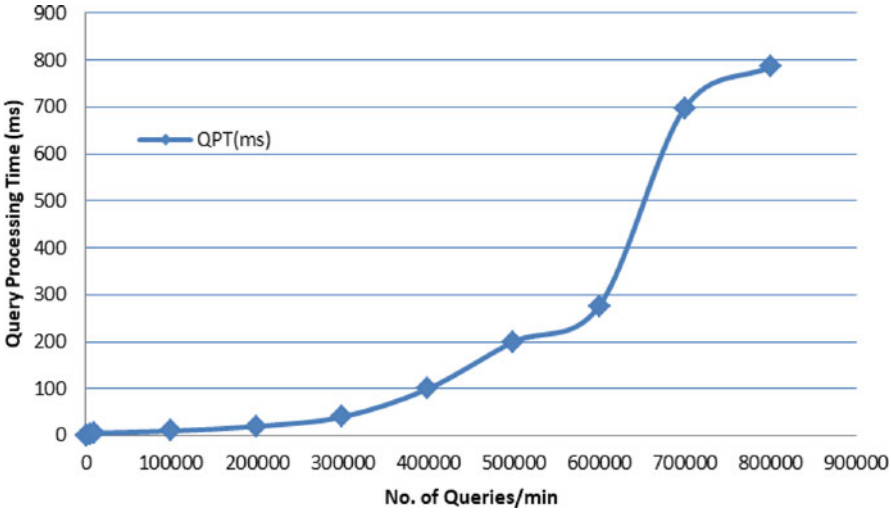

Fig. 6 Query processing time (QPT) without fault

system of the government of India does not warrant food guaranty for every poor in the locality of every province. Further, it also does not warrant weekly unemployment record like the United States. But NAFMAS governance system warrants all kind of citizen-oriented applications.

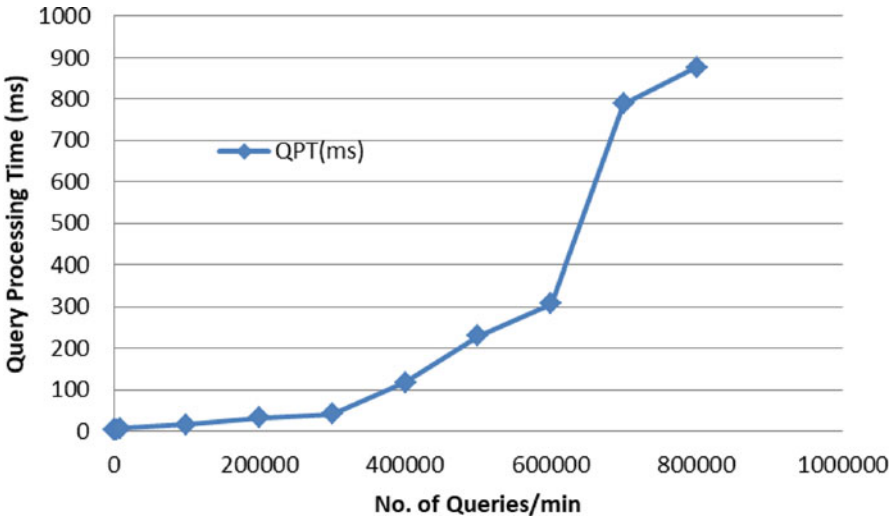

Fig. 7 Query processing time (QPT) with fault

9 Conclusion and Future Work

This chapter gives a look of n-layer NAFMAS system for promoting e-governance toward a hi-tech world. NAFMAS layers are working in hierarchical fashion. Both internal and external services are available to the citizen of a country. PMADE is playing key role in the deployment of the said system. Citizens are allowed to use 16 WAs simultaneously to accomplish their task across the world. A WA is a mobile and intelligent agent and is enough for the dissemination of work/accessing the information. NAFMAS integrates fault tolerant and reliability attributes from PMADE for the implementation of successful e-governance system. NAFMAS-based governance system warrants most of the citizen-oriented applications, viz., daily food for the poor in the vicinity of a province. Weekly unemployment record of citizens maintains at provenance level. NAFMAS card warrants every human-related application identities to food guaranty, income tax to voting, etc. But UDAI only warrants identity to the citizens of India. In future, more rigorous properties of the said system will be tested.

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