A Conceptual Framework For Implementing Priority Based Segregation For Decision Support Applications

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***Abstract*- In this research paper, priority is used as a heuristic. In a given problem space containing hub and spoke type networks, priority is used to identify priority networks, as those with free capacity available to service requests. A priority function is used to identify such networks, which can be used to satisfy priority service requests. The general decision making process is explained first including concept of Meta data. After that the corresponding problem model is formulated. Finally agent based architecture is constructed for implementing this framework. The Conceptual design of the agent that performs the segregation is also done.**

Keywords: Priority; priority functions; priority based segregation; priority networks; priority service requests; agents, etc.

I. Introduction

Metadata is data about data that is information about other information. e.g. libraries usually group books by subject. In that context the metadata about the book is the subject. Digital cameras allow people to take pictures, in this context the data is the picture taken and the metadata is information about the picture taken like when (the date and time), where (perhaps using information from GPS), or how it was taken. For example, the photographic exposure details are also metadata about a picture taken by a digital camera.

Theories, heuristics, concepts, Meta knowledge, facts and rules are the nature of Meta information. Now, if we partition this knowledge according to type, each sub category will form a separate field. Accordingly it can be noted that heuristics is a type of Meta information and form a distinct sub type of it. In this research paper it will be shown that Meta information can be captured in a template, which consists of distinct fields, one out of which is the heuristics field. Note that priority is a heuristic and forms a distinct field of the Meta information template. In further analysis, it will be shown that a priority variable assumes different values and according to its particular value, different inferences can be drawn.The objective of this research paper is to show how priority values can be captured in a decision support template through the use of priority function. There after a reference to this template gives the priority value, which is used thereafter for decision support in different types of situations and applications, though the generic concept remains priority based segregation, used for decision support.

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Capturing this information in a template means that the template can be deployed as an object also and subsequently queried in a distributed architecture implementation. We consider Five examples to introduce this concept – namely:

Process Scheduling.
Toll booth traffic Analysis.
OPD management in a hospital.
Computer networks.
Hub and Spoke model- used in decision support [1].

Application	Priority Variable	Significance
Process Scheduling	Process CPU burst time.	Shorter jobs get priority.
Toll booth traffic analysis	Vehicle type and Average waiting time / vehicle.	Some Vehicle types get priority over others. Some counters also get Priority.
OPD management in hospital	Average waiting time/ patient and average length of waiting queue at counter	Counters can increase to reduce waiting time. Neglected patient types can get priority.
Computer networks	Throughput in network.	Which network gets priority and which process gets priority.
Hub and Spoke model	Network type	Which network is designated as a priority network? priority networks can service priority patient types (priority service requests).

Table 1: Showing application of priority in various applications.

1. Process Scheduling: As in operating systems, the highest priority process is selected and priorities can be externally assigned or it can be internal to the system that is provided by some algorithms or it can be a combination of external and internal methods. Similarly here the p field can be used to provide the priority. For example in health care systems priority can be observe between various patients according to their service requests profile or their arrival time etc. Therefore, this paper has very important application in deciding the priority.

2. Toll Collection Booth: Here we are interested in traffic segregation, identifying both traffic type and also priority service counters. Queuing model simulation is an important part of the system.

3. In Data Warehouse: Meta data provides a catalog of data in the data warehouse and the pointers to this data. In addition to locate the data, Meta data contains information about:

(i). Structure of the data
(ii). Data extraction/transformation history
(iii). Data usage statistics
(iv). Data warehouse table sizes
(v). Column aliases
(vi). Data summarization/modeling algorithms
(vii). Attribute hierarchies and their definition
(viii). Business metrics and their definition
(ix). Performance metrics/confidence levels, etc.

Data mining, heuristics and other algorithms exists to perform data abstraction.

4. Computer Networks: Although various algorithms exist for the removal of congestion in computer networks. One of the methods for regulating access to a communication network is to use a data processing system. The data processing system employs a component that can be implemented in hardware logic or software. The component regulates access to the priority queue. All access to the priority queue or transmit channel must pass through this component, thus subjecting all communication transactions to rejection or tracking by the component. The component allocates a frame size based on the information to be transmitted and the priority to assure the transmission will be completed in line with the quality of service required. The component monitors the rate and size of messages to assure that an application's actual throughput does not exceed its negotiated throughput. The component, moreover, is capable of operating in correction mode where throughput and frame size violations are prevented and reported.

5. Hub & Spoke Model: It is a DSS model that can be used in load balancing, manpower planning and equipment planning etc. Hub and Spoke model framework was proposed by Vohra [1] where we are interested in knowing which network should be a priority network.

The purpose of this research paper is to use a priority function(s) to determine which network should be a priority network and another agent to determine which service requests are the priority requests, which can be redirected to be serviced by the identified networks.

II. Review of Literature

The Hub & Spoke model for health care delivery has been described by Vohra [1]. Collaboration between Hub and Spoke type networks in the form of load transfer, using the concept of Meta data has been described by Vohra et al [2]. Priority is a well established parameter used for CPU Scheduling in design of operating systems [3]. The task of priority functions is to establish priority so that important tasks are done first and get precedence over lower priority tasks. Another task of priority functions is to manage conflicts [4]. In the research problem at hand, the priority function is tasked with identifying networks with free capacity, so that they can handle in coming patient service requests. This is done by examining the value of the priority function, as each network has a corresponding priority function value, which is computed by dynamic traversal through the network. The function value can only be one of the following: negative, zero and positive [5]. Since the networks are dynamic and change, the concept of priority functions here uses dynamic priority computation. In the case of patients, we use class based segregation, setting up a priority flag. In this case priority setting is static. An agent matches priority patient requests to priority networks [6]. Priority functions can be implemented like a normal function. This enables different code to be run at different priority levels. Different priority levels can be assigned to such functions. This application is most suitable for real time operating systems (RTOS) [7]. Priority functions can be encapsulated inside a task and a priority functions scheduler can implement time slicing [8]. Objects can be assigned different priority levels e.g. a data structure or a resource. Functions can then perform operations on various objects with various priority levels. This concept of priority objects helps to define priority resources and data in the system [9]. Network traffic is classified in VLANS by use of user priority field. The traffic classes have been defined in the IEEE 802.1D user priority class descriptions. The mapping of user priority to the number of available traffic classes can be tabulated also, by a mapping table [10]. Brandstatter et.al model and test the priority heuristic in predicting people's choices in certain game playing situations [11]. The Priority heuristic consists of priority rule, stopping rule and decision rule. While the priority rule equals traversal of the priority function values of all the networks in the problem space, the stopping rule details when to stop traversal of the problem space. The decision rule is making the actual choice [12]. Shu-hsien Liao has discussed military command and control decision support [13]. Xin Ye et.al has described architecture for an emergency decision support system [14].

III. General Decision Process of Servicing Patient Requests in a Priority Based Network Space

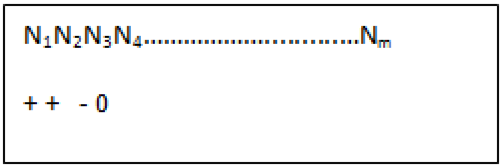
Given a problem space of Hub & Spoke type networks $N_1N_2\ldots N_m$. We are required to direct incoming patient service requests to the networks with servicing capacity i.e. those with free capacity. The decision support application requires identification of the networks with free capacity. This is done by examining the value of a priority function that is associated with each network.The networks $N_1N_2N_3\ldots.N_m$ have $P_1P_2P_3\ldots.P_m$ as the corresponding priority function values in their associated networks. Vohra et. al [2] have proposed a meta data structure for capturing meta data about each network. This structure is as follows:

Name of Hub	Names of Spokes	Free Capacity at Hub	Free Capacity at Spokes

Accordingly, a network with a positive value of free capacity will be able to service patient service requests and is a priority network for this task. Hence it can be stated that:

F > 0: p is +ve : Priority Network.
F < 0: p is –ve : Non Priority Network.
F = 0: p = 0: Non priority Network.

Where F is free capacity of the network and P is priority function value. Thus we get a list of priority networks out of the total networks in the problem space, for which P (Priority Function) has a +ive value. These are the Networks that can satisfy patient requests for service.



In the above figure we see network names in the first row with corresponding priority function signs in the second row. It can be seen that N_1 and N_2 have positive signs and are positive valued, hence these two networks can be segregated as priority networks, from the above discussion. Now, the further segregation of patient service requests can follow two protocols:

a. All patient service requests are at par (Figure 1).
b. Patient service requests segregated by priority, by setting a priority flag (Figure 2).

In both the cases, the redirection of patient service requests to the networks identified for servicing such requests is done by an agent. We assume it to be a software agent.

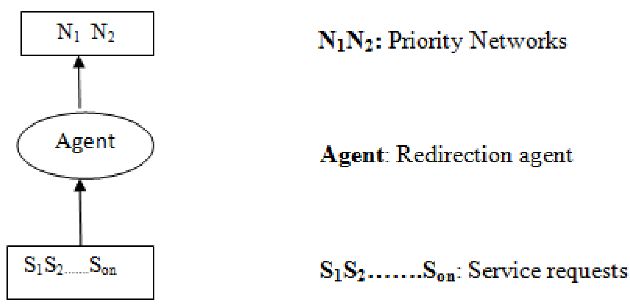


Figure 1: All patient service requests are at par

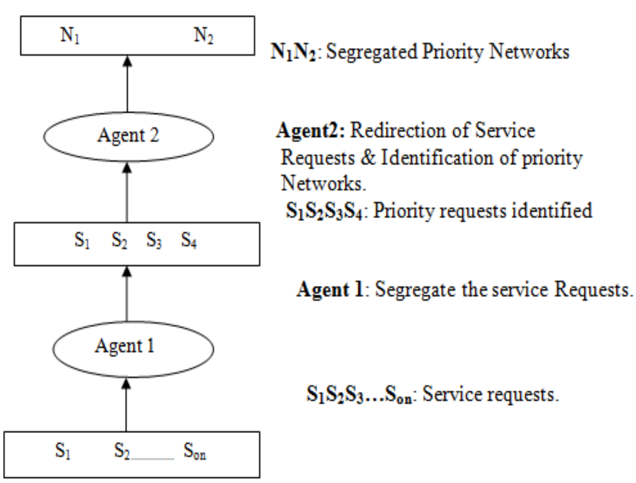


Figure 2: Patient requests being segregated by priority by setting the priority class for service requests.

Note: The priority class can be set in the user registration form of patient service requests, for a patient, depending on various criterions like emergency cases, type of patients e.g. defense personnel, government staff etc and economic criterion e.g. poor patients.In reference to figure 2 above, the design of the software agent, agent 1, responsible for segregating priority service requests is the subject matter of a full research paper. Hence its basic operation can be described at this point.

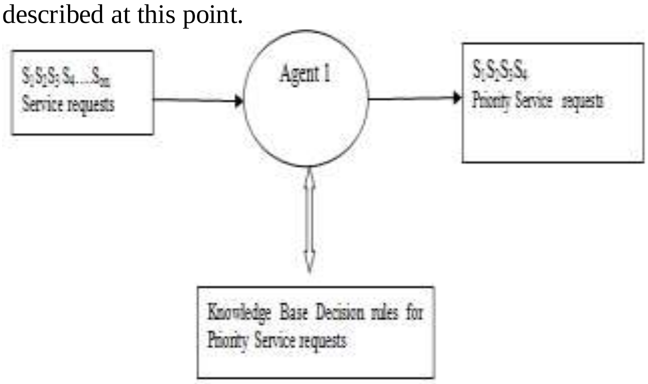


Figure 3: Operation of agent1

The basis of this segregation can be economic criterion (giving priority to lower income patients), service request profile, emergency requests and inputs obtained from queuing analysis, data mining systems and analysis of usage patterns, about which service requests should be classified as priority service requests. The choice and simulation can be made interactive.

IV. THE PROBLEM MODEL

4.1 Problem Definition: Create a conceptual framework to implement priority based segregation in A network space, using priority functions, where in service requests are to be redirected to priority networks. This redirection is performed by a software agent

4.2 Key Elements of the Problem Model

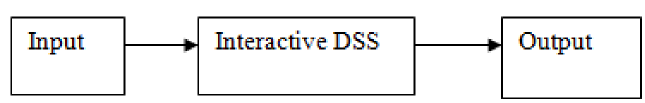


Figure 4: Key elements of problem model.

Input: Service requests, Network space
Output: Priority networks **Computation:**

- Matching priority service requests to priority networks.
- Agent based segregation and redirection of service requests to identify priority networks.
- Design of priority function to identify priority networks.
- Computation of priority class for service requests, thus getting priority service requests.
- Design of software agent with interfaces and processing logic to perform redirection of service requests to priority networks.

Decision Support Analysis:

- Identifying priority networks.
- Generation of priority function values for all networks in the problem space.
- Setting priority class (decision rules) to a service request.
- Identifying priority service requests.
- Description of networks that can satisfy incoming service requests.

V. AN AGENT BASED ARCHITECTUR

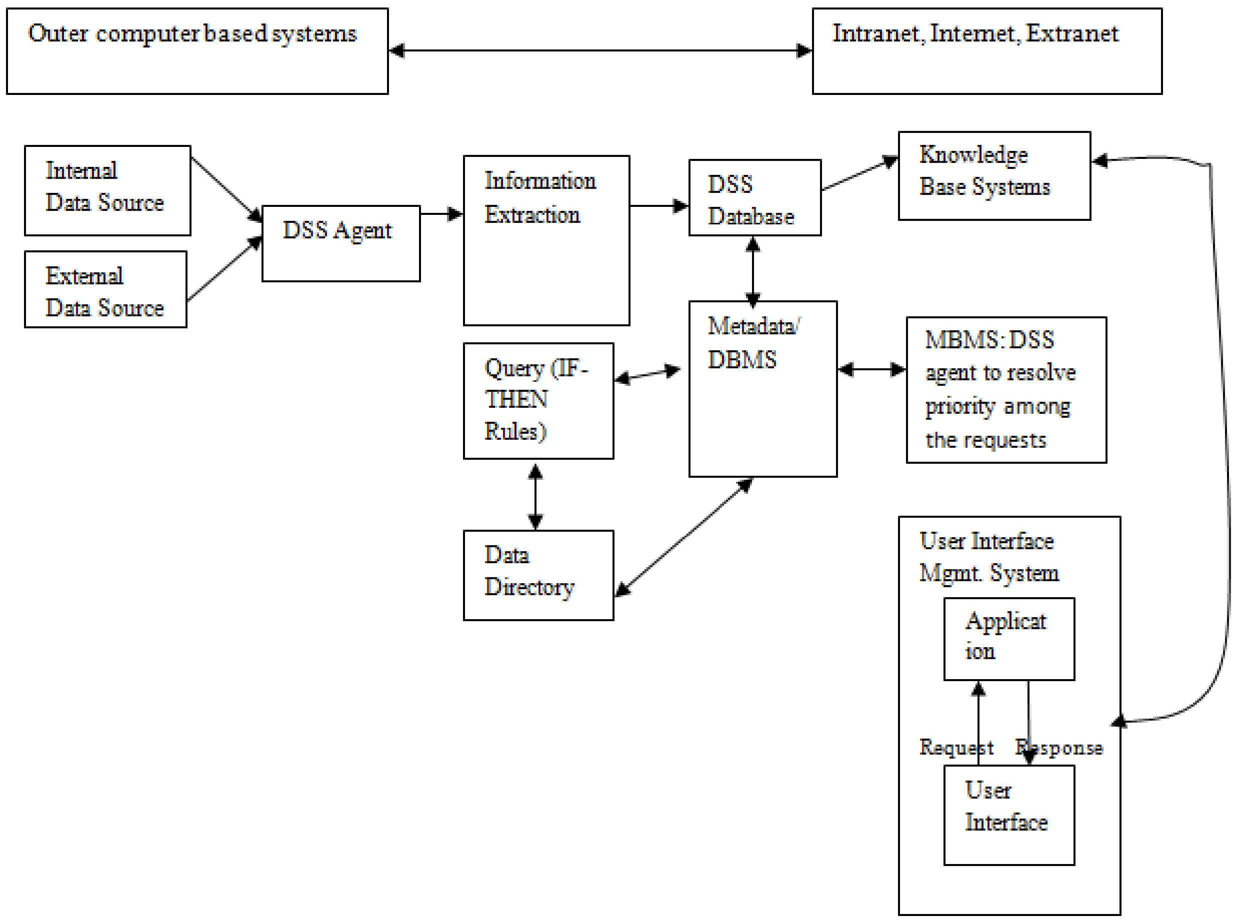


Figure 5: Model of an agent based DSS architecture

Description of Figure 5:

1. DSS Database: This stores the data of service requests, network data and Meta data for each network in the state space, patient information and priority function values etc.
2. Query Facility: Querying the system for information related to identified priority networks, segregated service requests and Meta data values for each network in the state space. *Example*: which networks are priority networks.
3 Data Dictionary: This gives the definition and description of all data elements used by the system. *Example*: name of network, attributes of a service request, patient details etc.
4. DBMS: The DBMS manages the data stated above in terms of retrieval, updating, insertion and deletion. *Example*: Viewing Meta data for a network.
5. Extraction of Data: Extracting priority service requests and identifying priority networks in the given space are examples of data extraction.
6. Model Management System: The algorithms to manage the twin agents for classifying service requests, redirection of service requests to identified priority networks form the core of the model management software. Also, managing and capturing the priority function values is a key task here. This conceptual model is manipulated to obtain priority based segregation.
7. Knowledge Base Management: The knowledge base can store service request classification rules and decision rules for identifying priority networks. This can interface with the software agents to complete the agent based architecture and framework for implementing segregation.
8. User Interface system: An interactive menu driven system for model manipulation, priority segregation, model querying, managing the service requests and overall system design using menus and other UI constructs. *Example*: View

Priority function values for each network in the given problem space

VI. Conclusions & Directions for further research

This research paper presented a conceptual agent based architectural framework to implement Priority based segregation for Decision Support applications. The concept of Priority Functions has been used to identify priority networks, while another agent consults Decision Rules to classify patient service requests into priority service requests. The functionality of twin agent architecture to implement this has been illustrated. The Design of an Agent using Priority functions to identify priority networks has been shown through a flow chart.In further work, detailed design specifications of these two agents can be done. In addition, pseudo code to implement the agents can be written. The interaction of these agents with a customized Decision support system (DSS), can be taken up for software implementation. Also, the classification rules for obtaining priority service requests can be written in software, and use of this Knowledge base made to perform this segregation.The various components needed to implement this segregation model can be integrated together and a software prototype developed for the same. In addition, Priority functions can be used for suitable applications in Computer Networking- for example how to identify a priority computer network. The concept remains valid though the algorithm and parameters vary. Real time Priority based segregation, using an Agent based architecture can also be used for segregation of vehicular traffic at Toll gateways. The design of agent1 (Fig 2), tasked with segregating priority requests can be done in a full research paper. Also simulation of different criterion for this segregation will lead to further research work.

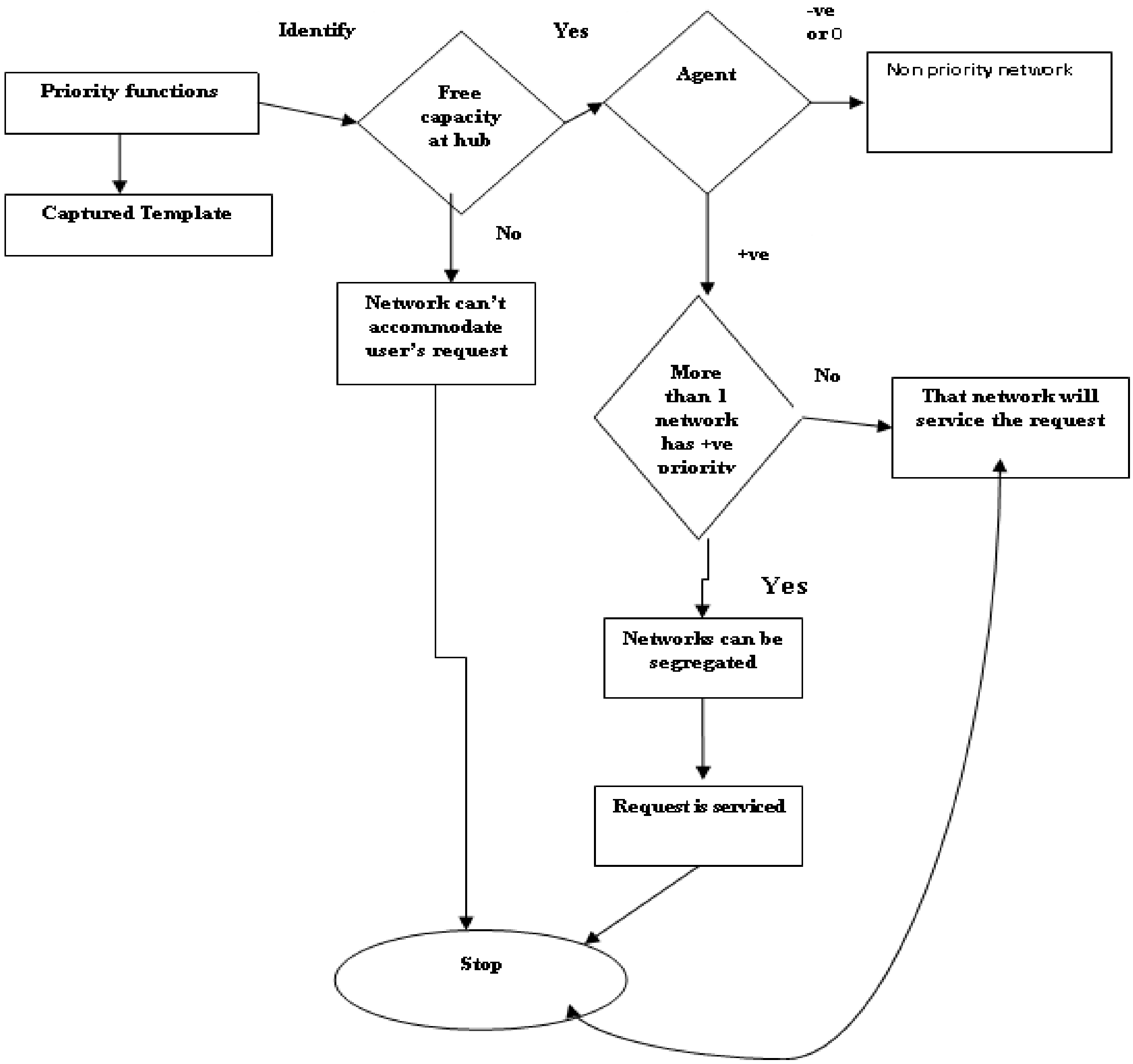


Figure 6: Operation of an agent to identify priority networks using priority functions

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