

# CICV: Cross Indexing and Cross Verification Algorithm Based Service Discovery in Pervasive Computing

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**Abstract—** One of the drastically growing industries is pervasive computing where it integrates human, smart devices, cloud and internet. Number of devices and number of people using services in pervasive computing is increasing day-by-day. Due to dynamic changes in scalability it is very difficult to select and provide an accurate service to the user request. In this paper, Cross-Indexing and Cross-Verification (CICV) algorithm is used to investigate and provide an accurate, relevant service to the appropriate user requests in time. CICV creates and maintains the information about the devices and services with location information including other Meta information for selecting and providing services to the user requests. Also CICV provides services in three different ways as unicast, broad cast and multi cast according to the requests similarity, which reduces the time and computational complexity. The simulation is implemented in NS2 software and the results are compared with the existing approach results in order to evaluate the performance of the proposed approach.

**Keyword-** Pervasive Computing, Service Discovery, Service Description, Service Selection, Ubiquitous Computing.

## I. INTRODUCTION

In recent days lots of innovative devices are built and integrated into human daily life. Integrating computing devices is termed as pervasive computing and is our future of the computing environment. Traditional PCs, printers, mobile devices, plotters and handheld devices, wear and devices used in commodities environments are integrated mainly. RFID tags, iPods, smart phones and other different kinds of sensor devices are already ubiquitous. The devices used in pervasive computing are increasing in terms of numbers as well as types create more challenges. The challenges are number of devices increasing dynamically and accessing the devices, network services are difficult. Most of the devices are inaccessible. Due to the new devices integration the old network services are added and old network services are removed. Service discovery is simply recognizing the available services in a network and the user can requests and utilize them [5]. Discovering services in pervasive computing environment is necessitating mechanisms for more effective.

The main objective of the pervasive computing environment is to provide an efficient service discovery as a service oriented computing paradigm. A big challenge is to develop a service discovery protocol where it allows all the users and the applications to interact with each other in an efficient manner. The service provision should be a relevant service, in-time, secure and efficient manner which does not violate the privacy of the users. In order to provide quality communication and network services it is essential to improve the service discovery in pervasive computing [1]. Pervasive environment based research works mainly concentrates on network services to be discovered properly, configure and make communication among the devices using a protocol. These kinds of protocols are called as Service Discovery Protocols (SDP). Also these protocols take care of installing the device drivers and configure all necessary network service configurations automatically. The main advantage of service discovery is used to reduce the administrative overhead greatly. Nowadays the environment users and the system administrators are communicating manually. It is infeasible by the system administrator for managing the services, discovering services among more than 1000 devices in a network without any protocol.

In order to manage dynamic service discovery the SDP uses soft states and lease-based services in pervasive computing environments. The service states maintain the information and Meta information about the services and service provision. Lease based services provides Client Server (C/S) accessibility in determined time interval. SDP will take care of client's services access renewal. There are three things to be considered in pervasive computing. First, computing environments are different with their boundaries whereas the physical boundaries are disappeared. For example a device inside a human shirt-pocket is not accessible by others but devices which connected in the pervasive environment can be shared by all the other devices connected in the

pervasive network through the bus near the device in the packet over wireless networks and executes the service discovery routing protocol. But whenever the environment gets changed many security solution are getting failed [2]. Second, the numbers of services deployed in pervasive computing are in heterogeneous environments. Many services and service providers are exists in a same place are homogeneous. For example, in A's office, the company provides network services. When A and A's colleagues carry and wear devices and shares with each other, they become service providers. Including that services provided in the same city where they are located may also be accessible from A's office. In order to provide security in cloud service providing it is necessary to investigate the privileges applicable to the services and to the user request during service discovery. Same time un-authorized users cannot discover or access pervasive discovery services even they are in the same locality. Privacy cannot be sacrificed without any proper protection. For example a malicious attacker can find and fetch the health information about a mobile user by connecting through a medical device. Finally increasing number of devices, services and service providers it is more complex to manage the pervasive computing. Availability, usability are serious challenge problems in pervasive computing. It is easy to make feasible where the users can remember and identify the services according to the associated passwords, certifications from different service providers. This leads to improve the memorize power the relationships among services and service providers. This feasibility is taken into account and this paper provides a novel solution to improve the efficiency of service discovery and service provision using CICV algorithm. The entire contribution of this CICV algorithm is:

- List all the services in a Service-Index File
- List all the devices in terms of locality
- Update the service and device information dynamically in a time period.
- Cross verify and provide service by service discovery.

## II. BACKGROUND STUDY

This section presents various methodologies and procedures used to do service discovery and service provision in pervasive environment. One of the author in [3] said that the goal of the pervasive computing environment is to provide easy service for users. Also a client is an entity which needs services and using service as a tangible or intangible facility can be useful to communicate with other devices. All the clients have to do registration in the pervasive directory in order to operate and use pervasive operations [4]. Services can be provided in terms of investigating the requests. In directory-less protocol a request is sent to all the nodes very near around to the client, so that the nodes and the information can be passed and the service discovered [4]. One of the authors [5] told that directory-less architecture is more efficient for pervasive computing environment since it don't require other infrastructure. Number of mobile subscribers is increasing up to 3 billion marks worldwide [8]. The objective of ubiquitous computing is integrating small devices, computing and communication capabilities with human [9] in order to assist human to perform their tasks anytime from anywhere throughout the world. Integrating devices in to provide Service Oriented Architecture (SOA) [10] where it is useful and it can support transparent integration of software and hardware in ubiquitous environment [11]. Since mobile environments are extremely dynamic providing relevant/accurate [12] and fast/efficient [13] service are necessary. Service discovery in ubiquitous environment brings more novel opportunities and new challenges [14, 15]. So that people provided context-aware service discovery for mobile environments. Also several approaches like Business Process Execution Language(BPEL) [16] are used as an orchestration language for services.

## III. PROBLEM STATEMENT

Describing a service is also a problem in pervasive computing. It is a problem of having knowledge about the physical world and balancing accuracy according to service constraints. Description of services consists of information about a service and through which only the protocol can choose the service matched with requests. The description of service must contain as much as possible information about the services. But in recent days no service discovery solutions are deploying enough information about the physical world can understand and use the pervasive computing resources. Another problem in pervasive computing is selecting relevant service. The decision maker confused about the information given for a service in terms of the number of variables added. All of this information means that decision mechanisms must be complex and take into account any information the service consumer deems important. In this paper, the problem of service discovery in pervasive computing is taken into account and it reduces time complexity, resource consciousness in heterogeneous environments and improves the accuracy of service's relevancy according to the requests via CICV algorithm.

## IV. CROSS-INDEX AND CROSS-VERIFICATION

In this paper, Cross-Indexing and Cross-Verification algorithm is used to map the incoming request with the available services in order to satisfy the customer. More number of recent researches is active researches presently going on. In this paper CICV is designed with certain criteria and choices to improve the efficiency of the service discovery and service provision. CICV is a computing resource used by users, user programs, or by

other services in the pervasive environment. Here it is assumed that our proposed scenario uses printing services, software services, location information and wireless network connection services.

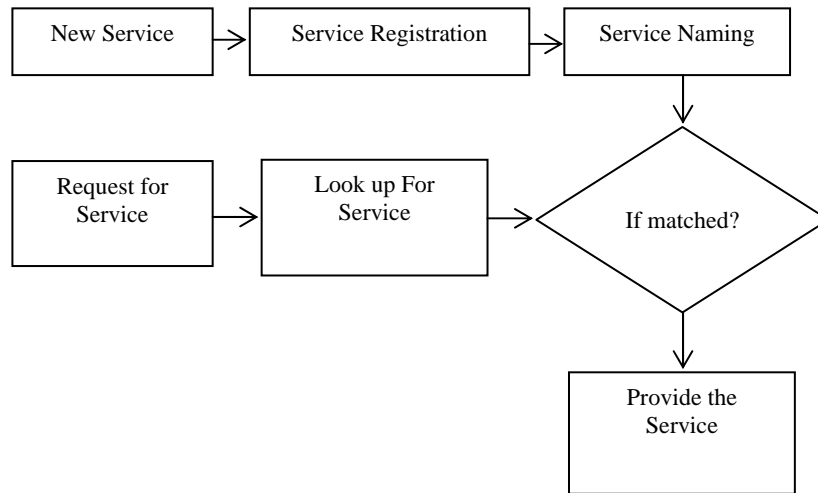


Fig. 1. CICV Model

### A. CICV Network Model

In a graph  $G$  (pervasive environment), there are  $N$  number of services are deployed as

$$S = \{ S1, S2, \dots, Si, \dots, Sn \} \forall i = 1 \text{ to } n$$

and  $K$  number of nodes are interconnected in to  $G$ ,

$$N = \{ N1, N2, \dots, Ni, \dots, Nk \} \forall i = 1 \text{ to } k,$$

whereas  $G$  is represented as  $G = (N, E, S)$ .  $E$  is the edge interconnecting nodes and services. The set of all input requests

$$R = \{ R1, R2, \dots, Ri, \dots, Rm \} \forall 1 \text{ to } m.$$

The set of all attributes of a service can be written as

$$A = \{ A1, A2, \dots, Ai, \dots, AL \} \forall i = 1 \text{ to } L$$

When a request comes into pervasive environment, the following conditions are verified as:

$$\left\{ \begin{array}{l} R_i \leftarrow S_i, \text{ if } (RMI(S_i).exists = true \text{ and} \\ \text{if } (mode(S_i) == Idle) \quad \text{and if } (A_i(R_i) \approx A_i(S_i)) \\ \text{else} \\ \text{Look for other } S_i \end{array} \right\}$$

If the requested service is indexed in RMI, the attributes are matched and the service is available then the service is assigned to the request. Else the CICV look for other services to the request.

### B. Service Naming

Each service in the world has a name for identify purpose. Suppose a person “A” uses a plotter, then the “Plotter” is the name of the service that “A” uses. Though the problem is when “A” looks for a plotting service, a plotter calls itself a plotter service. Then “A” is unable to find the plotter [2]. Most of the service discovery protocols solve this kind of problem by defining a service naming standard, it eliminates the naming conflict. The devices are assigned with numbers which maps service names as index. Defining services in SLP can follow any templates [3] in the earlier research works. But in this paper CICV follows an efficient method for service naming for easy service discovery. Similarly for mobile devices, the services frequently changed from one domain to another domain due to mobility, where the mobile client needs to understand various service protocols and use various vocabularies, for example: saying Plot service one time, printing service one time and plotter service another time.

Here, CICV creates unique names for all the registered services while entering into the pervasive environment. CICV name the services in terms of their locality. For example a service “S1” is entering in to the pervasive environment CICV gives name is given below. By utilizing the codes from the tables in Figure-2, the CICV generates an  $SN$  for each service. These names are persisted in a ReMote Indexing (RMI) table used for further comparison.  $SN$  for the 789<sup>th</sup> node is 029:241:2178:9000. This  $SN$  assigned by the pervasive computing for mapping the services. This 029:241:2178:9000a generated service name created by the CICV, where it is a unique name which never conflict while service discovery and service provision.

C. Service Discovery

Discovering a service is finding a best matched service for user request. When a user request for a service, the requirement is analyzed and finds a service from the RMI table. The set of all services are persisted in various servers or in a single server but their reference name is persisted in RMI table. One of the main attribute for each service is name. During service mapping the CICV concentrates more on mapping on the name. In order to obtain the accurate service discovery the entire attribute  $att_i \forall i = 1,2,3, \dots, n$ . A score value (S) is calculated according to the number of attributes matched. The score value is calculated using the following equation as:

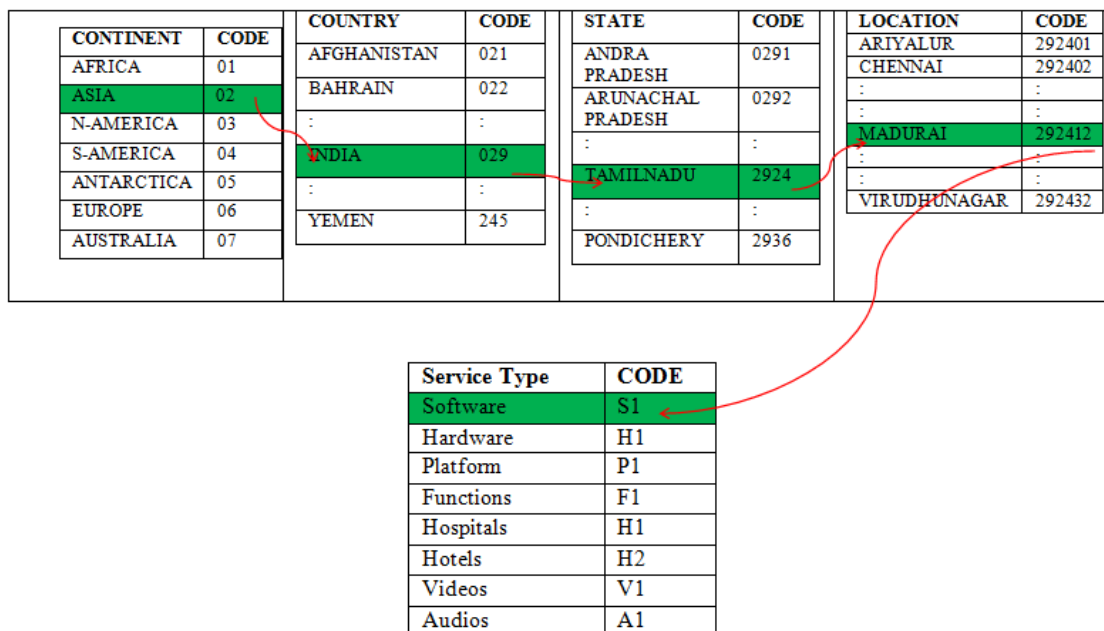


Fig 2 Service Name (SN) Generation

$$S = \sum_{i=1}^n V_i \times P_i \times W_i$$

Where,  $P_i$  is the polarity of the  $i^{th}$  attributes,  $V_i$  is the actual value and  $W_i$  is the weight. The service is selected when the  $S$  value is high. Once the service is discovered then it is assigned to all the requested users in the pervasive environment. After obtaining a list of service matching and the number of services are more than one, then the attributes of the services are extracted by the CICV associated with each, by retrieving the polarity and actual values of every subclass of service-attributes associated with a matching service. For a Plotter service the service discovery component queries the shared indexing database and determines that is there any service can have Plotter and it can be provided to the request.

D. Service Distribution

Once service is discovered it is assigned to the user sent request. Most of the time same service can be requested more number of users. If the request is for cloud resources the cloud server virtualize the resources to all the users at the same time. The location information verified in order to provide the service distributedly using multicast or broadcast. A virtual LAN is created among the users who requested same resource at the same time. Providing the same service to multiple users can be done by multicast or through broadcast. RMI table is used to cross verify the incoming request with the availability of the resources. The entire process of CICV is written in the form of pseudo code and it is given below to implement and verify the performance of the proposed approach.

Algorithm CICV ( )

```

{
    for I = 1 to L
    {
        if(request.name == RMI.name) then
        {
            if ( Si.mode == Idle) then
            {

```



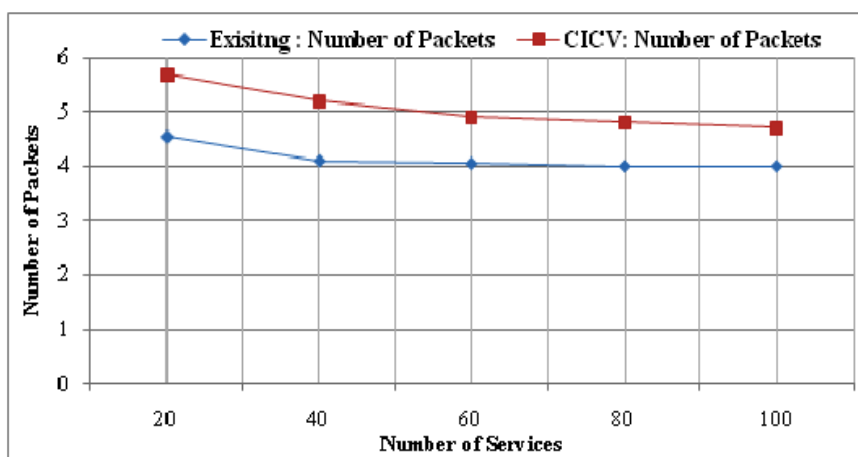


Fig. 4 Number of Services and Number of Packets

During the service discovery process the status of the service is verified whether it is “Idle”. By attending this point number of packets produced is different. It is illustrated in the Figure-4. As Figure-4 shows, if activity of the services decreasing, producing the number of request packets are increases. Request packet should be sent to other nodes instead of matched service, this point is correct. From this figure, if the availability of the service is 99% then the average of produced packets increases to 0.05. Also in CICV the service availability is more than existing approach due to fast and efficient service provision completion. Number of discovery obtained by CICV is more than the existing approach and due to that the number of packets also increased in CICV execution.

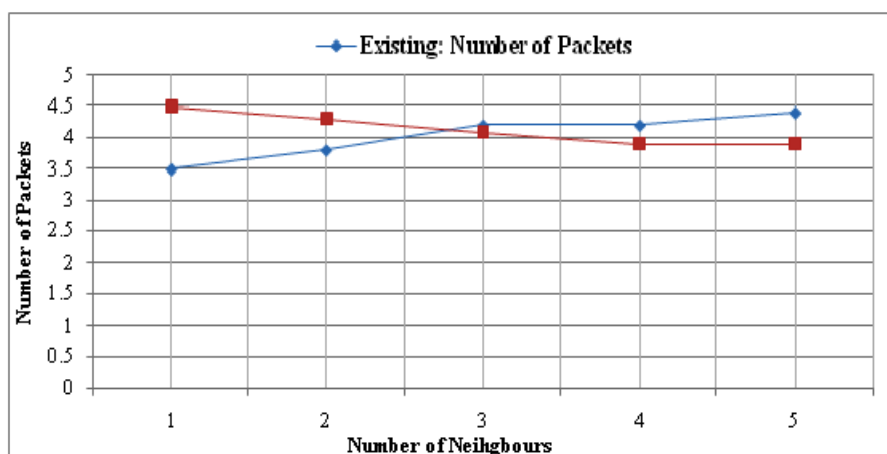


Fig. 5 Number of Neighbors and Number of Packets

When an input request packet does not discover in client or its cluster, it has to send to neighbors. From the result of Figure-5, it clear and concluded that if a request packet send to neighbors, number of packets produced will be more, and the CICV shows better packet transmission than the existing approach.

### VI.CONCLUSION

The main objective of this paper is to discover an accurate relevant service for all the requests come inside pervasive environment. In this paper we propose CICV methodology for improving the service discovery by eliminating the conflict on the service names. To do that a novel naming service techniques is utilized in the CICV where it investigate the requests and available service attributes to map the services with the requests. RMI table is used to represent the naming service and the service information with the request information is mapped together to find the matched service which is in idle mode. CICV provides common understanding, reasoning, searching and match-making the services. From the results it is concluded that CICV is efficient than the existing approaches in terms of service discovery and service provision. As future work, we plan to support wide-area discovery and investigate mechanisms that enable users to specify discovery preferences in an unobtrusive manner.

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