Cross Layer Issues in Service Discovery on Pervasive Computing: An Approach

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ABSTRACT
Pervasive computing, with its focus on users and their tasks rather than on computing devices and technology, provides an attractive vision for the future of computing. This paper, we create the new layered architecture for pervasive computing and discuss the responsibilities of each layer. Service discovery enables devices and services to properly discover, configure, and communicate with each other. Service discovery is identified significant pervasive computing, hence the proposed architecture we present separate layer for service discovery tasks. Cross layer design approach would helps to blend the responsibilities and increase the life time of network in the pervasive computing environment. The paper presents the comparative study of different cross layer design techniques and how service discovery procedures are analyzed and compared.

Keywords
Pervasive computing; cross-layer; service discovery;

1. INTRODUCTION
Pervasive computing provides an attractive vision for accessing information anywhere and anytime. Such environments gracefully integrate networked computing devices from tiny sensors to extremely dynamic and powerful devices with people and their ambient environments. A room, for example, might be saturated with hundreds of devices that provide information to people without seeking their active attention.

Service discovery is essential to achieving such sophistication. It enables devices and services to properly discover, configure, and communicate with each other. Service discovery protocols are designed to minimize administrative overhead and increase usability. By adding a layer of indirection, service discovery protocols simplify pervasive system design. In the paper, we create an exclusive layer for the discovery process.

Cross layer design may be defined as, "the breaking of OSI hierarchical layers in communication networks". The breaking of OSI hierarchical layers or the violation of reference architecture includes merging of layers, creation of new interfaces, or providing additional interdependencies between any two layers. In this paper our new layer architecture followed the cross layer design approach for increasing the pervasive computing performance.

2. LITERATURE REVIEW
[1]Pervasive computing can be labelled by 3 A's: Anytime, Anywhere and Any device. [2] Pervasive computing is the result of the convergence to three areas of traditional computing: personal computing embedded systems, and computer networking. [3] Service discovery enables devices and services to properly discover, configure, and communicate with each other Service discovery protocols play a key role in wireless sensor networks. [4] They provide to the mobile nodes a functionality that enables them to advertise and discover service providers. A cross-layer design is given as any violation or modification of the layered OSI reference architecture. The intent of CLD, simply stated, is to exploit information from multiple layers to jointly optimize performance of those layers.[5]In the cross-layer approach each layer can share information with any other layer

3. PERVASIVE COMPUTING LAYERS
Pervasive computing is the result of the convergence to three areas of traditional computing: Personal computing, embedded systems, and computer networking. It can be distinguished from computing in general by its emphasis on: ubiquity, interconnectedness and dynamism. Like the OS1 model, this model is layered.

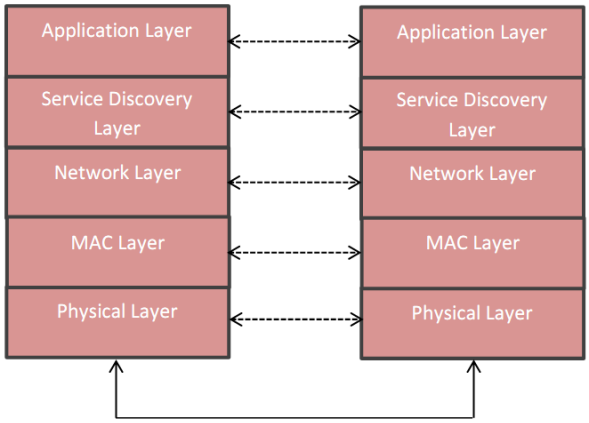

Fig 1: Pervasive Computing: A Layered Architecture.

3.1 Physical Layer
The physical layer is concerned with transmitting raw bits over a communication channel. It receives analog symbols from the medium converts them to digital bits for further processing in higher layers. The physical layer is typically thought of as consisting of the hardware aspects of the pervasive system. By this we mean the user's body and the signals it is capable of sending and receiving. Many pervasive computing applications involve speech recognition and user biometric identification for

security purposes – the flow of control in such an application depends on the signal received from the user's body. The design issue in the physical layer will be to ensure that its entities are physically compatible with one another. The functioning of physical devices and human physical responses in the pervasive system depends on the surrounding environment.

3.2 MAC Layer

This MAC Layer commonly referred to as layer 2, interfaces with both network and physical layer. The Medium Access Control layer provides the opportunity to reduce the energy and prolong the network lifetime. The MAC layer provides the reliable delivery system and privacy security option. The MAC layer break up the input data into frames, transmit the frames sequentially and process the acknowledgement frames send back by the receiver.

3.3 Network Layer

The network layer commonly referred to as layer 3, provides end-to-end routing. The primary function of the network layer is route packets of information. Pervasive system is the dynamic environment. A key design issue is determining how packets are routed from source to destination. The network layer deals with routing and connectivity of nodes in the pervasive system.

3.4 Service Discovery Layer

The exclusive layer to interface between both network and application layer. The service discovery layer is created by merging of different layers such as service discovers layer, service composition layer and service execution layer which follow the cross layer design issue methodology. The separate service discovery layer is provide the efficient scalable of service discovery process.

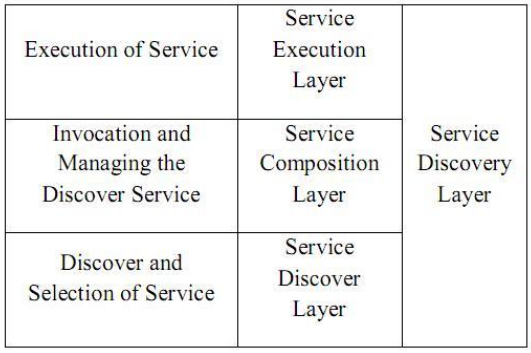

Fig 2: Service Discovery Layer: A Cross Section View.

Service discovery is viable and scalable through this separation of discovery layer. The protocols are designed to minimize administrative overhead and increase usability. By adding a layer of indirection, service discovery protocols simplify pervasive system design.

The services discover layer is used to discover the services by using the service discovery protocols. It also used to select the service. The service composition layer is used to request the service and managing the discovered services. The service execution layer is used to execute the selected service. In our layer architecture these layers are merged using cross layer design and create the single layer that is service discovery layer.

3.5 Application Layer

The application layer is similar to the application layer in the OS1 model. The key issue that must be addressed in this layer is maintaining consistency between the users reasoning and expectations and the logic and state of the application.Desktop users have the luxury of on-line help systems, Internet access, and bookshelves. These items will not always be available to pervasive computing users, as we assume tiny sensors are deployed across the environment that are proactive but more important is the fact that pervasive computing activity will tend to be more immediate and focused.

4. SERVICE DISCOVERY IN PERVASIVE COMPUTING

Service discovery is an increasingly important issue as we move towards realizing pervasive systems. How does the user identify and access a particular service from the plethora of services that may potentially be available around him at any moment? Having discovered a service, a second important issue is how the user interacts with it.

The pervasive computing systems are not like the common desktop pc network, but are composed of small-embedded devices, communicating in a wireless network independent of any global management. This is where the field of service discovery fits in. For a device to be truly mobile, it must be able to interface and co-ordinate with its surroundings without the user's intervention. For this to happen, the service discovery protocol must be able to discover local resources and form an ad-hoc network. Thus, ubiquitous service discovery is the ability to discover and form an ad-hoc network without explicit user direction.

According to (8) the service discovery protocol has ten main components. They are service and attribute naming, initial communication method, discovery and registration, service discovery infrastructure, service information state, discovery scope, service selection, service invocation, service usage and service status inquiry. Many of the organizations developed the service discovery protocols, some of the protocols are given in= the following table.

Table 1. Few Service Discovery Protocols

Service Discovery Protocol	Developer of the Protocol
Bluetooth SDP	Bluetooth Special Interest Group
DEAPspace	IBM
Intentional Naming System	Massachusetts Institute of Technology
Jini Network Technology	Sun Microsystem

Rendezvous	Apple Corporation
Salutation protocol	Salutation Consortium's
Service Discovery Service	University of California
Service Location Protocol (SLP)	Internet Engineering Task Force's
Universal Plug and Play (UPnP)	Microsoft

In the proposed service discovery layer structure, the service discover part deals with discovery scope component and the service composition part has taken service invocation component and the service execution part is in service usage component. Over the past few years, many organizations have designed and developed service discovery protocols.

5. CROSS-LAYER DESIGN ISSUES

Cross-Layer Design may be defined as the breaking of OSI hierarchical layers or the violation of reference architecture includes merging of layers, creation of new interfaces, or providing additional interdependencies between any two layers.

In the cross layer approach each layer can share information with any other layer. But in the OSI model each layer has predefined functionality and can use only the services provided by the layer below it. The cross-layer approach can be performed in four ways:

I. Creation of new interfaces between the layers for information sharing at run-time. It can be done into three ways: upward (from lower layer to a higher level), downward (from higher level to a lower layer), back and forth (iterative loop between two layers);

II. Merging of adjacent layers to a new super layer without creating new interfaces;

III. Design couplings two or more layers at design time without creating new interfaces;

IV. Vertical calibration across layers can be done statically by setting parameters at design time or dynamically at runtime.

Cross-layer can provide application specific performance. It can hide the differences of various platforms from higher layers. It has many interlayer interactions, big design and optimization space, the algorithms and system design are more complicated and challenging.

5.1 Challenges

Power energy is the main criteria for increase the life time of the network system. The power energy deals with physical, MAC and network layer. The cross layer design technique helps to use the low power energy. It also increases the performance of the pervasive system.

Pervasive computing environment is known as rapidly changing network. Hence the characteristics of the Network, Protocol, User and devices are also keep changing. The dynamic nature of the network causes hands full of problems including service discovery. The new layer designed for service discovery task is crucial to handle maximum flaws due to hardware and user interoperability. Recognizing a service and executing requires a common entity among the heterogeneity. Fig. 3 illustrates the methods of cross-layer design to overcome the challenges.

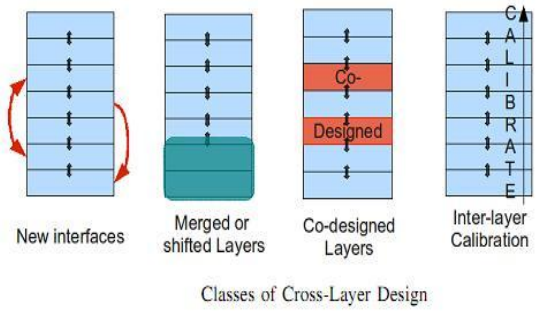

Fig 3: Classes of Cross-Layer Design.

The upward type of cross layer design provides effective service discovery process. The information sharing from low layer to upper layer helps to access the service. But upper to lower layer information sharing system not provide effective service access.

Table 2. Different Cross Layer Design and how they support Service Discovery Process

No	Cross-Layer Design	Service Discovery Process		
		Service Inquiry	Service Invocation	Service Execution
1	Creating new interface • Upward • Downward • Back & forth	High At least Minimum	High At least Minimum	High At least Minimum
2	Merging of two layers	High	High	High
3	Co-designed layers	Low	Low	Low
4	Inter-layer calibration	Low	Low	Low

In our layer architecture for pervasive system, the three different service oriented layers merged together and create the new service discovery layer as mentioned earlier. This exclusive

layer may function effectively for the consequent tasks of discovery. As in the table2 the co-designed and inter layer calibration methodology of cross layer design providing less effective than other previous methodologies.

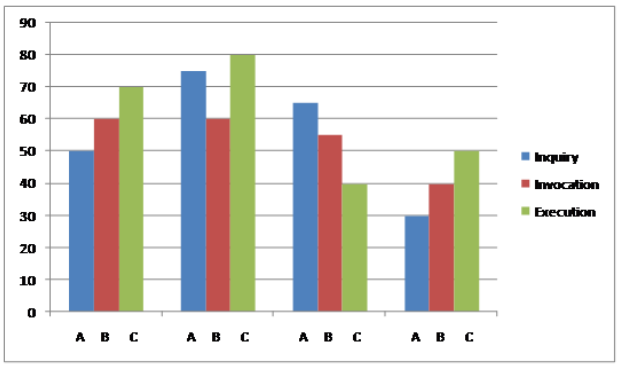

Fig: 3 Compares methods of cross-layer design with the responsibilities of Service discovery

. The focus and concentration of service discovery amongst any of the cross-layer design methods are portrayed. Creation of new interfaces at service inquiry level requires fifty percent of the operational requirements whereas it requires seventy-five percentages at merging of two-layers. Service inquiry level requires sixty five percentages at co designed layers. It requires thirty percentages for inter calibration layer. In service invocation it requires sixty percentages of creation of new interfaces and merging of two layers. In co-designed layer the service invocation level requires fifty five percentages whereas the inter calibration layer requires forty percentages at invocation level. Creation of new interfaces at service execution level requires seventy percentages and it requires eighty percentages at merging of two layers. The service execution level requires forty percentages of co designed layers. It requires fifty percentages of inter calibration layers.

6. CONCLUSION AND FUTURE SCOPE

The paper attempt to provide a new layered architecture of pervasive computing. The architecture follows a cross layer design methodology for making a service discovery layer. Service inquiry, service invocation and service execution are the internal activities in a service discovery. Finally the paper also presents a comparative study of different cross layer methodology and how they support service discovery process. The future work will implement and analyses the performance of this layer approach in a simulated environment.

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