Wireless Middleware

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INTRODUCTION

Middleware is not a new concept in distributed computing. It was first accepted as a term used to describe distributed software architecture during the 1990s and has evolved significantly since then with the increase in computer networking and the resulting use of distributed systems. The following is aA definition of middleware that was proposed by Emmerich (2000) and embodies the concepts of middleware: "Middleware is a layer between network operating systems and application components which facilitates communication and coordination of distributed components" (p.120).

Middleware has become widely adopted in industry to simplify the problem of constructing distributed systems as it resolves the heterogeneity between systems and provides higher-level primitives for application engineers to focus on application requirements and not their connectivity.

Wireless middleware, as a specialized subset of middleware, has come into increased significance in the current decade due to the proliferation of wireless networks. Additionally, in the last few years, there has been an upsurge in the development of the mobile devices sector. Personal Digital Assistants (PDAs) and a new generation of cellular phones have the ability to access different types of network services and run many applications. To cope with these innovations, the role of wireless middleware has become increasingly important in providing a reliable channel for data access between mobile devices and servers on a wired network. This provides applications running on the mobile client to synchronize with and participate in the application dialogues that are hosted on the enterprise servers.

Wireless middleware is an intermediate software component that is generally located on a wired network between the wireless device and the application or data residing on a wired network. The purpose of the middleware is to increase performance of applications running across the wireless network by serving as a communication facilitator between components that run on wireless and wired devices (Wireless Nets). Wireless middleware serves as a communication facilitator by addressing the numerous ways in which communication can fail among components in a distributed application. Sources of communication failure, among many others, include a component going off line voluntarily but unexpectedly, a component unexpectedly terminating, a component failing to respond to a request in a reasonable amount of time, and communication being severed in the midst of a request (Sunsted, 1999).

TYPES OF WIRELESS NETWORKS

Currently there are two distinct types of wireless networks that can be categorized by their transmission range and that differ significantly in the latency and bandwidth characteristics of the transmission.

Fixed Wireless Networks

Fixed Wireless Networks use wireless transmitters with a relatively short transmission distance and normally correspond to one of the IEEE 802.11 standards. Networks of this type have many of the characteristics of fixed wire networks, such as low latency, high bandwidth, and relatively good reliability. These networks tend to be used in a specific area such as a Starbucks coffee shop, an airline lounge, or a corporate office. For wireless networks of this type, the standard middleware that is normally employed in wired networks and can be used as such are the de facto standard interprocess communication mechanisms such as XML and SOAP, which are becoming increasingly common.

Highly Mobile Wireless Networks

These wireless networks are used predominately to serve highly mobile clients such as mobile cellular phones or satellite communications. Networks of this type have extremely high latency, relatively low bandwidth, and greater unreliability, as any number of interruptions can occur to disrupt the communication with the client. As this type of network is increasingly becoming used for M-commerce, specialized middleware is required to cater to the additional challenges.

It is this type of wireless network (i.e., high latency, low bandwidth, unreliable, and insecure networks) to which the remainder of this entry refers.

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CHALLENGES FOR WIRELESS MIDDLEWARE

Wireless middleware is presented with many challenges by the very nature of the wireless environment. These challenges are not adequately addressed by standard data communication methods that were designed for wired environments. One of the main advantages of middleware is to allow applications to run on multiple platforms without the need to rewrite them. As such, wireless middleware should support heterogeneous devices, permit applications to be ported from one device to another, and, in addition, handle the limitations of mobile devices, among which are the small amount of memory and the lack of processing power. Wireless middleware on mobile devices has some distinct issues not present in traditional fixed line systems.

Disconnected Operation

Wireless communication devices tend to lose and regain network connectivity much more often than non-mobile applications. The middleware must be able to cope with intermittent communication links and implement software layers that ensure the delivery of important data between the server and the wireless device.

Resource Constraints

Mobile applications must be optimized aggressively for small ROM and RAM footprints, as well as for low usage of CPU cycles and battery power.

Multiple Bearers

Internet applications only need to support HTTP or TCP/IP. Wireless applications are written to perform on many different networks. A bearer in a wireless network is a transport mechanism of which wireless bearers could be SMS, GPRS, Infrared, Bluetooth, or HTTP. An application written for one bearer typically needs to undergo substantial modifications in order to run on another bearer.

Heterogeneous Software

There are a number of operating systems that are prevalent in the wireless device market. Because of the memory restrictions placed on these systems, they do not possess all the features of server operating systems. Thus, it is often difficult to ensure that the middleware can effectively run on all the required hardware devices. Often, features that are available on one device are not available on another device with a different operating system. For example, object serialization, which is a standard method of communication for components between clients and server systems, is not available in Windows CE.Net. Thus, programming communications between components where the device is a CE device require the applications developer to interface with a middleware product that cannot serialize objects.

Security

Security is a key concern in a mobile environment. Identification, authentication, and data encryption must be embedded into wireless middleware applications.

Scalability

As a result of the proliferation of wireless devices, scalability of applications can easily grow to hundreds of thousands of client systems. Ensuring the scalability of applications to this number of clients presents a major problem.

Deployment and Management

Deploying applications to many clients, managing them, supporting them, and ensuring their integrity and support when they are not online, present another major challenge to the middleware.

COMMERCIAL SIGNIFICANCE OF WIRELESS MIDDLEWARE

The development of application software such as M-Commerce applications and client/server applications should not be designed so they are independent of the network over which they are deployed. This ensures that applications do not require to be rewritten for new technologies, and the applications developer and business enterprise can concentrate on the business benefits of the application and not the technology on which they reside. For example, a stock ordering application running on a PDA for a manufacturing concern should integrate with the manufacturing schedule in the corporate head office. The speed of taking the orders, scheduling them, and getting them in the production schedule is what is important to the manufacturing company. Wireless middleware provides this network transparency and enables wired applications to be ported to wireless environments with the minimum of software modification.

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