Mobile Management

Market Drivers for the Foundation of The Open Group Mobile Management Forum

April 2000

THE Open GROUP

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EXECUTIVE SUMMARY

This Document

This document provides an overview of the key enabling wireless technologies and hindrances to the early adoption of wireless data solutions, and thus defines the market drivers behind the foundation of the Mobile Management Forum (MMF) by The Open Group. It also sets out proposals for specific activity within the Mobile Management Forum.

This document can be expected to evolve to reflect changes in the market and technology, and discussions within the Mobile Management Forum itself.

The Open Group

The Open Group, a vendor and technology-neutral global consortium, is committed to delivering greater business efficiency by bringing together buyers and suppliers of information systems to lower the cost and risks associated with integrating new technology across the enterprise. Recognizing that standards alone are insufficient, The Open Group's mission is to deliver assurance of conformance to Open Standards through the testing and certification of suppliers' products.

The Open Group and Wireless and Mobile Computing

In early 1999, The Open Group membership identified the growing importance of wireless and mobile computing and initiated a study to identify key areas where The Open Group could make a significant contribution towards enabling the emerging market for corporate wireless data applications.

The first stage was the creation of The Open Group wireless computing web portal, www.openwirelessdata.org, to categorize and analyze the large number of existing wireless standards efforts.

Subsequently, The Open Group embarked on a six-month study of the wireless computing market, involving in-depth interviews with leading wireless vendors and early adopters of wireless technologies. The interviews have served to refine and validate The Open Group's views on its role in accelerating the adoption of wireless data solutions into the enterprise environment. These meetings took place in both Europe and North America and were conducted by **Gregory Gorman**, Director of The Open Group's Wireless and Mobile programs, and **Peter George**, Principal, Wheatstone Consulting (UK), a UK-based consultancy company that provides strategic advice on mobile data solutions.

The Open Group's essential conclusion is that the enterprise and wireless markets are converging but still face serious obstacles. Integration of wireless data devices and applications into the enterprise environment is seriously impeded by the lack of interoperable standards and solutions.

This executive summary highlights the major findings of the research and identifies concrete proposals for action by the new Open Group Mobile Management Forum.

The remainder of this document, co-written by The Open Group and Wheatstone Consulting, provides a more detailed exposition of the key technology areas affecting the deployment of wireless data in both the corporate and consumer markets.

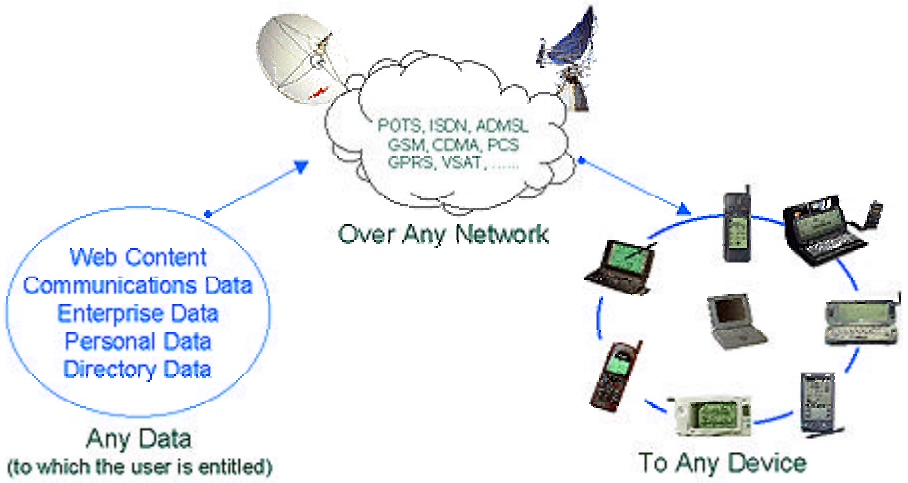
The Mobile Management Forum

On April 12th 2000, The Open Group launches the Mobile Management Forum (MMF), based on:

- The results of this research
- The views of existing members of The Open Group
- The broader demands of the market

The MMF's overarching objective is to accelerate the deployment of wireless data into the enterprise environment, by leveraging its vendor and user membership.

Its vision is deceptively simple, to allow a user to access any information (to which he/she is entitled) over any network via any device:



Initially, the Mobile Management Forum is invited to focus on five key areas which the research clearly identified as barriers to attainment of the vision:

- Session management of wireless and mobile devices and applications
- Wireless and mobile data synchronization
- Wireless Local Area Networks (LANs)
- Wireless data device-independent content origination
- Authentication, authorization and accounting issues related to wireless data devices and applications

In each case, this document highlights the issues, examines the problems, and offers a set of pro-active recommendations to drive the market forward.

The Role Of The Open Group

The members of the Mobile Management Forum will determine the programs and projects of the Forum.

- In instances where pre-existing standards bodies and industry organizations are already doing important work on wireless data standards, the role of The Open Group should be complementary and supportive. For example, The Open Group has developed close working relationships with the Personal Computer & Communications Association (PCCA) and the WAP Forum.

- In cases where The Open Group has identified unmet needs, these will need to be addressed within the Mobile Management Forum. In such cases, The Open Group will be able to deploy one of its most powerful assets – the strong vendor and corporate/government buyers membership base – to drive interoperable standards that will move the market forward.

- In all other instances, the Forum should work closely with other parties driving forward wireless data standards to make sure that our efforts are properly coordinated for the benefit of the wireless data community and meet the full needs of customers.

Session Management of Wireless Mobile Devices and Applications

Background

Fixed connection networks, by design, provide an effective platform for file and resource sharing or group interaction within (relatively limited) local areas. The architecture of these networks is optimized for this environment–assuming the presence of a dedicated, high-bandwidth, highly reliable network connection which incurs no incremental usage charge. When applications developed for these networks are deployed to large numbers of users who are not continuously connected by a high-bandwidth, highly reliable network connection, they exhibit inherent limitations that become increasingly evident as the number of users increases.

The architecture of fixed connection network systems does not provide a complete range of capabilities required for effective enterprise-scale wireless and mobile computing solutions. They lack the economy of operation, transparency of underlying management during a connection employing unused bandwidth, ease-of-use, and administrative flexibility required to automate core commercial business processes successfully for large numbers of wireless and mobile users.

One characteristic that all network connections have, but that becomes more evident and pressing in an occasionally connected model, is the need for session management.

During the research many interviewees identified the **session management layer** as a key component of wireless data interoperability in the enterprise environment. The Open Group believes that if a standardized approach to session management can be established, significant progress can be made to accelerate the deployment of mobile data into the enterprise environment.

The Role of The Open Group

The Open Group's newly created Mobile Management Forum (MMF) should leverage its membership of wireless suppliers and enterprise buyers to work with the vendors of existing management products serving enterprise use of wireless and mobile computing in order to agree to a **Common Session Management Layer** (CSML) which would define interoperability and compatibility of architectures.

Specifically, the functional requirements of session management should be abstracted to form a general, open architectural layer to support the wide range of other management services such as data synchronization, file and software distribution, accounting, security, content distribution/transformation, and so on. It is critical that the session management standard as implemented ensures interoperability

by having open external interfaces for the support of multiple applications and is supported by the major players in the wireless and mobile market.

To deliver this result, the Mobile Management Forum should seek to develop a standard reference model for session management. The standard reference model should make it possible for solutions providers to automate and manage the exchange of information between applications and databases that reside on host systems with wireless or mobile users, regardless of their location, or the wireless device type they are using.

This would need, among other things, to include several key concepts:

- A complete architecture must be independent of the transport layer and accommodate common transport protocols.
- It should offer consistent reporting of failures and allow for automated restart of a session in case of any failure.
- Remote control of wireless devices without a direct connection is required for remote device support.
- The protocol should provide a set of implementation rules that support and bridge the range and levels of application development protocols employed to build a solution.

The protocol should also offer open integration for most existing computing and communication environments in order to leverage existing customer and third-party investments in these technologies, while providing interoperability between various disparate members of a trading community.

Wireless and Mobile Application Synchronization

Background

As the reach of wireless and mobile systems continues beyond personal productivity tools into the realms of corporate applications, users increasingly trust and depend on the integrity and timeliness of data that spans the host and the various mobile platforms–a mobile phone, and handheld computer, or a laptop. Reference data on the multiple devices must be current, transferable, and reliable.

Data synchronization is the term used to refer to this reconciliation operation where updates are exchanged and conflicts are resolved. These data synchronization activities are performed over a session management layer. Synchronization across different platform and applications sounds at first pass to be a single action to harmonize data across these platforms, but in reality it involves multiple levels of carefully defined activities to rationalize the contents of two or more sources of data (across one, two, or more platforms). This last dimension, spanning a broad range of data types across a range of operating systems, database systems, and devices, offers a significant challenge in the quest for interoperability. There is no accepted implemented standard today for addressing this need–there is a proliferation of different, proprietary data synchronization mechanisms for mobile devices.

The absence of a single data synchronization standard was identified as a major hurdle for end-users, device manufacturers, application developers, and service providers over a year ago in early groundwork leading up to the formation of The Open Group's Mobile Management Forum.

In February 2000, IBM, Lotus, Motorola, Nokia, Palm, Psion, and Starfish set-up SyncML (**Syn**chronization **M**ark-up **L**anguage). SyncML has set forth as its goal to develop and promote an open universal standard for synchronizing data across different computer platforms, networks, and devices. SyncML is an XML-based data synchronization protocol supporting data synchronization (email, calendar, contact management information, as well as enterprise data stored in databases and web-based documents) while aiming to be open enough to accommodate new forms of content available in future.

The Role of The Open Group

The Open Group should support the activities of the SyncML group.

The Mobile Management Forum should work closely with SyncML (and similar organizations) and the existing players in the market to ensure that the solutions fully meet the needs of users and integrate and interoperate effectively with the proposed Common Session Management Layer (CSML) work.

Furthermore, The Open Group should encourage close interaction between the Mobile Management Forum and SyncML, so that the corporate/government user community will fully appreciate and support initiatives to create an open interoperable data synchronization protocol.

Wireless Networking

Background

The first commercially available Wireless LAN technologies appeared in the mid to late 1980s. The major requirement at first was mobility–to give employees the capability to roam with a computing device and still have connectivity to the resources available on the corporate LAN. Early implementations were in specialist industries such as warehousing, manufacturing, retail store management, and public utility environments where computing traditionally could not go and yet where significant productivity benefits were to be gained if such solutions were implemented. As a result, early adopters of the technology were able to justify isolated implementations of proprietary technologies in discrete locations.

The growth potential for this wireless technology is particularly interesting in the home, and small business markets. In the home, and for the small businesses sector, removing the need to invest in a fixed wiring infrastructure provides cost efficiencies and flexibility. To quote Mack Sullivan, Managing Director of the Wireless LAN Association: "Because there's no wiring, they take their system with them; they can set up the system themselves and save money on installation, too".

Various WLAN Standards Have Emerged

The industry is seeing the major players developing and adopting multiple current and emerging standards in wireless LAN technology. The various technologies implemented by vendors in the market are based on the work of such standards organizations as the IEEE LAN Interoperability Group (802) and ETSI.

In the late 1990s, a consortium known as the HomeRF working group was formed to focus on creating a shared wireless access protocol (SWAP) for interconnecting data and voice equipment in the home environment. This area was already being addressed by the European Digital Enhanced Cordless Telecommunications (DECT) standard.

In addition to these efforts, several leading wireless vendors led by Erricson, IBM, Intel, Nokia, and Toshiba, developed a wireless personal area technology named “Bluetooth”. This initial effort has led to the creation of an industry-driven Special Interest Group of over 1000 vendors. Bluetooth is an open specification for wireless communication of data and voice. It is based on a 9 x 9mm microchip, facilitating protected *ad hoc* connections for stationary and mobile communication environments. In addition to a hardware description, it also offers an application framework and interface support with interoperability requirements.

Bluetooth radio technology built into both the cellular telephone and the laptop will, among other things, replace the cable used today to connect a laptop to a cellular telephone.

The Role of The Open Group

The Open Group should facilitate industry cooperation to achieve alignment of the activities of Bluetooth, ETSI, HomeRF, and WECA to ensure that differences do not retard market growth, and conformance and certification testing programs are implemented to ensure end-user confidence.

There is an opportunity for The Open Group to leverage both its conformance and certification program skills and the power of its corporate and government buyers to promote a common industry consensus among the various competing interests for the purposes of driving forward adoption of these exciting technologies in the market.

(Wireless) Device-Independent Content Origination

Background

Internet content and services have to date been targeted at a *de facto* standard presentation device, a desktop computer. Regardless of differences within operating systems, browser technology, and version, the base-level content has been created in a uniform fashion and to a known and constant set of base requirements. When looking to extend the Internet to the wireless world one is faced with a range of mark-up languages and protocols for rendering Internet content on the range of form factors for wireless devices.

Wireless Application Protocol

Seeking to address this issue, the wireless industry has thrown its weight behind the Wireless Application Protocol (WAP). The WAP Forum, founded to promote WAP, is now supported by an expanding group of wireless equipment manufacturers, mobile telephone operators, software vendors, and content companies. WAP has become the *de facto* world standard for wireless information and telephony services on digital mobile phones and other wireless terminals. It is optimized for small devices and is based on the Internet client/server architecture. WAP introduces a wireless optimized mark-up language, WML, which is a subset of HTML, but introduces new syntax.

WAP has made significant progress since its inception in moving toward being an open standard, but certain obstacles still exist for an enterprise customer seeking to gain interoperability across various device types and across various implementations of WAP servers. Initial work by the WAP Forum did not address certain issues (including security and interoperability) in sufficient depth for the broader user community to be confident of the outcome. The Open Group is already working closely with the WAP Forum working groups to address these shortcomings.

The WAP Forum has further recognized that the WAP standard cannot exist in isolation and has signed a mutual cooperation agreement with W3C to ensure that the work between the two organizations is complementary in nature and enables seamless extension of Internet developments to the wireless environment.

The challenge posed by WAP is merely one example of a much more general problem which faces information providers. It may be acceptable to have specific point solutions to translate from standard HTML to WML for WAP, but this solution is not scaleable as the number of different device types and form factors proliferates. It is simply not possible for information providers to be aware of the specific characteristics of every kind of access device.

Two complementary approaches are currently evolving:

1. A standards-based approach from W3C, referred to as XHTML, includes facilities to profile both the original content “page” and the characteristics of the device. A single version of the original information is translated either by the server or browser for display on the specific device.

2. The second approach involves the introduction of policy-based intermediation systems, such as the recently announced WebSphere Transcoding Publisher from IBM. Such systems can and do utilize XHTML to profile content and devices, but are capable of much more, including protocol conversion and content filtering.

The Role of The Open Group

The Open Group should continue its close cooperation and support for the WAP Forum by delivering interoperability test suites and building a world-class certification program. As appropriate, The Open Group should try to bring to the attention of WAP members other initiatives which impact on the WAP standard, and will strongly encourage convergence with XHTML.

The Open Group should use its existing relationships with the suppliers of intermediation technology to ensure full integration with XHTML and common definition of extended transcoding rules.

Authentication, Authorization and Accounting in the Wireless Space

Background

Being able to connect any computing device to any other, irrespective of location, is a blessing coupled with security pitfalls. For an individual, free access to any resources on the Internet is enormously powerful. For anyone concerned with corporate security, it is a major headache exposing the trove of corporate confidential information assets, both to unauthorized access and potential misuse, as well as exposure to viruses, works, and other digital pollution.

If a remote LAN is connected to the Internet it is almost certainly protected by a firewall. The identification for access control and authority is normally the IP address of the calling device. Thus the firewall for a corporate LAN is normally configured to only permit external access by devices which have an IP address which is within a predefined range, or has been uniquely registered. Where the device is one which is normally used within the LAN, and is calling in via some form of Remote LAN Access (RLA) technology, the firewall will identify it correctly and thus grant access to the device. If the same device attempts to establish a connection across the public Internet via an ISP, then it will normally inherit a new IP address–allocated by the ISP for the duration of the session–and thus look like a foreign and potentially unwelcome visitor.

The situation is similar upon arrival of the mobile device at a remote site. In this instance, the device is allocated a new IP identity within the subnet in order for it to be accepted by, and receive network services from, the local routers and devices within the subnet.

This situation is further complicated by mobile devices which will exist within an IP subnet only for as long as they are in transmission range of the subnet. Firewalls therefore need to become a good deal more sophisticated in their recognition of mobile devices, if the user is to obtain a consistent access and service experience in accordance with their AAA (Authentication (who am I), Authorization (what am I allowed to do), and Accounting (how do you charge me for it)) profile regardless of their location.

There is much work currently underway in the Internet Engineering Task Force (IETF) to define the AAA requirements of mobile IP.

Many in the telecommunications industry claim that the IETF work is a duplication of effort. Cellular network operators have been able to authorize, authenticate, and account (bill) for voice call roaming for nearly a decade, and GSM data services such as SMS are already enabled for roaming across national boundaries with all the inter-network and customer billing taken care of within the infrastructure of the network. Notwithstanding these views, there is a clear need to bridge the Internet and telecommunications world. It would appear that the Mobile Wireless Internet Forum aspires to fulfil certain aspects of this need by bridging the old world of customer service and billing and the all new IP-based networks of the future.

The Role of The Open Group

The Open Group should continue to monitor closely the activities of the IETF Mobile IP and Security working group and the Mobile Wireless Internet Forum (MWIF) to assess the extent to which the problems of AAA in the wireless space are being effectively addressed.

Existing Open Group enterprise integration activities addressing Security and eCommerce (LDAP-based), Directory Interoperability, and Enterprise Management are clearly synergistic with the needs of the wireless environment. The Open Group is able to bring together experts from the Mobile Management Forum and its existing programs to ensure that the wireless needs are addressed in a way that ensures smooth integration with existing enterprise systems.

Introduction: The Market for Mobile Computing

Overview

Mobile computing is not new. Large enterprises have been enabling mobile workers with laptops and modems for over 10 years and mobile data technology is already being used for a wide variety of applications–electronic mail, messaging, corporate database access, fax transmission and receipt, job dispatch, online transactions, and basic file transfer. However, these deployments have largely been bespoke and fraught with complications, which have delayed widespread acceptance.

The two biggest constraints–lack of international standards, and a lack of a popular user application–have been largely removed by the Internet. The entry-level cost has also deterred growth in the private consumer market, until the recent introduction of more competitive tariffs, and a pre-pay model for the use of cellular telephone networks in the 142 countries worldwide which support the GSM standard.

Wireless data is seen by many as the future of the mobile communications industry. Mobile operators and Internet service providers have begun to work together (some organizations such as Vodafone/Airtouch and Sonera are even declaring themselves as fulfilling both roles) to deliver new wireless data services which have broad market appeal. Operators are already using the mobile phone as a device for delivering services other than telephony. In France, for example, you can already buy a soft drink with your mobile phone. Vending machines have phone numbers–simply dial the number of the vending machine and the device delivers your drink, charged to your cellular phone bill. Although this is not strictly a data application, it is beginning to shape the behavior of users to expect more from their phone than just talking.

Business applications, such as the provision of access to corporate intranets, are likely to drive usage of, and revenue generated from, the wireless Internet due to the user profile of being quality-sensitive and price-insensitive. However, consumer use will continue to grow rapidly. Globally, this view has recently been confirmed by two showcase examples: the exponential growth of Short Message Service (SMS) traffic in the European youth market, and the dramatic take-up of the NTT DoCoMo service “I-mode” in Japan.

Within three years, more than 100 million employees around the world will regularly work outside the boundaries of the enterprise, without the comfort of continuous LAN or high-speed WAN connections. The workplace will change forever, and this army of "location-independent" workers will share one common characteristic. They will be only intermittently connected to the corporate information systems upon which they depend to do their job. The trend is evidenced by the huge growth in laptop computing, the deployment of Personal Digital Assistant devices for corporate applications, remote access connections, and the use of cellular and packet radio technologies phones for data.

Over a year ago The Open Group membership requested a specific focus on the areas of wireless and mobile data. A working group was formed in the spring of 1999 and, following general industry research to identify opportunities for contribution, The Open Group conducted a six-month study of the wireless computing market. This study included in-depth interviews with key wireless technology buyers and suppliers, and drew the conclusion that the enterprise and wireless markets are converging but still face serious obstacles. Integration of wireless devices and applications into the enterprise environment is seriously impeded by the lack of interoperable standards and solutions. This document records the results of that study and, based on the feedback received, proposes concrete action by The Open Group and other key industry leaders to accelerate the full potential of wireless data in the marketplace.

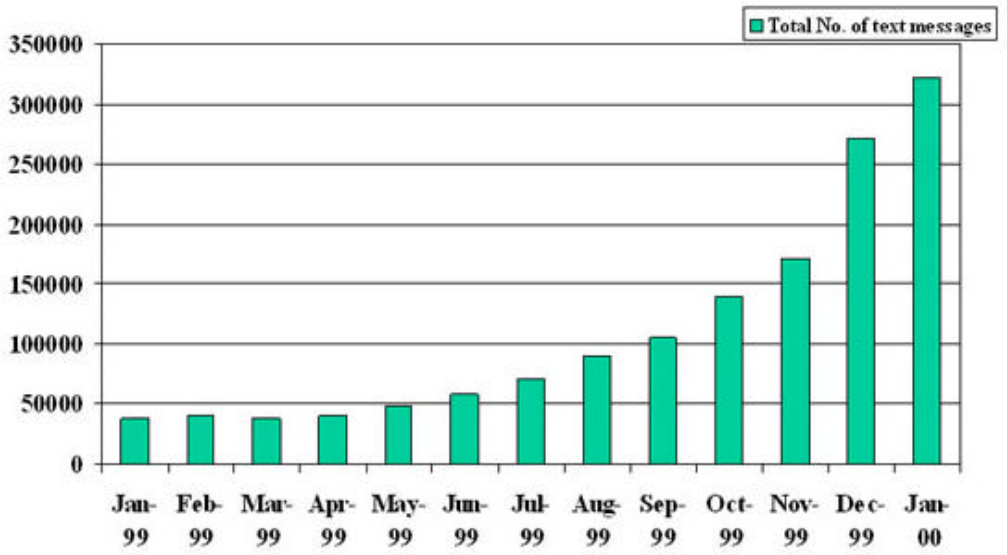
Early Signs of Growth Potential

Wireless and mobile data volumes are rapidly growing in Europe and 1999 can be regarded as the year when the European market for mobile data services finally began to achieve some of its much hyped potential. Similar growth has been replicated throughout the GSM world, and even bettered in the Japan PCS market. Meanwhile the North American market continues to suffer from the proliferation of incompatible digital cellular standards, which the “free market anarchy” approach has nurtured.

Encompassing the full spectrum of data services, from low bandwidth SMS applications through to high-end mobile multimedia services, we are now seeing data account for up to 6% of all service revenues on some of Europe’s cellular networks. The European growth trend in terms of subscription share between voice and data is reflected in the U.K. market predictions.

Text Messaging Growth (SMS)

U.K. GSM Network Operator Totals 1998-2000 (,000s)

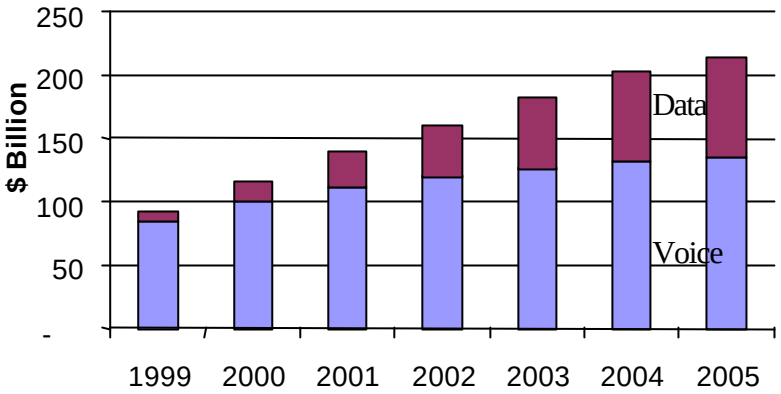


(Source: Mobile Data Association)

Figures released by the MDA in February show that U.K. SMS traffic increased by over 40m messages per month during January, doubling the figure reported three months earlier. As in most European countries, the primary usage of SMS in the U.K. has been in the youth market. Many anecdotes exist about the way in which teenagers use the service to announce meetings at coffee bars or cinemas, and how text messages are used as the only way to communicate between friends in noisy night-clubs.

The European cellular data market is now expected to increase from $4 billion in 1999 to $60 billion per annum by 2005. Initially this will be fueled by the continued growth in SMS traffic. In the short to medium term, 2.5 Generation services, including HSCSD, GPRS, and EDGE technologies, will have a major role to play in the development of the market and full 3rd Generation data services are expected to account for 57% of total cellular data service revenues by 2010.

European Cellular Voice and Data Revenue Growth



(Source: Ovum 1999)

Inhibitors to Market Growth

The dramatic growth of mobile telephony has shown how important it is to users to have convenience and freedom to talk. The Internet, with it's ease-of-use and availability almost to the point of ubiquity in most computing resources, offers the potential for equally dramatic growth in mobile data.

Technology on its own will not drive the growth of usage and revenue. For business and consumer users alike, it is applications which deliver valuable personal utility that will create a willingness, or even a preference, to use a mobile device for commerce transactions. Low bandwidth data services are already in demand as can be seen from the uptake of SMS-based messaging and other consumer-oriented novelty applications. Messaging from short-message to full email will continue to offer greatest short-medium term utility for business users and consumers alike.

Beyond this, growing Internet penetration is driving existing Internet portals, such as AOL and Yahoo, and cellular operators to create new portal-related content delivery products such as customized, regular delivery "push services" including sports results, stock market pricing, and weather data; irregular "pull services" such as cinema listings, concert programs, and train time requests; and location-based services including identifying local outlets, cash-point machines, restaurants, and personal or in-car navigation including congestion avoidance. In line with wired Internet portals, advertiser sponsorship will be a key driver and revenue generator for the consumer market, although brand reinforcement on the currently available screen real estate presents a new set of challenges for dot com organizations.

High-end "interactive multimedia" applications will ultimately prevail but there are some limiting factors which must be overcome including network deployment, terminal design, and availability, and above all appropriate and acceptable tariffing for the connectivity, data, and services to be delivered.

All of the building blocks (SMS, WAP, network upgrade paths, flexible tariffs, new device formats, Internet growth, user awareness) are falling into place to stimulate greater demand, but there are still some major challenges which lie ahead. Specifically these are achieving the correct design of multipurpose mobile devices, overcoming the reliability and interoperability issues on WAP servers and devices, and ensuring and maintaining the quality of service and roaming on new "data" networks as they upgrade through from 2G to 3G.

Given that the growth of mobile data was inhibited by a lack of standards which analysts claim the Internet has solved, it is curious to note that the projected growth for the next 24 months is based on the availability and ease-of-use of two technologies which are new, not sanctioned by any of the Internet standards groups, and for the most part peculiar to GSM and the cellular telephone handset. These are Short Message Service and Wireless Application Protocol.

Whatever solutions are proposed, it will benefit the industry, enterprise, and consumers alike if the technical elements are accomplished within, or seek to create, agreed standards which ensure global interoperability, and which can be subjected to a full conformance testing and certification regime.

Session Management for Wireless and Mobile Devices

Overview

Fixed connection networks, by design, provide an effective platform for file and resource sharing or group interaction within (relatively limited) local areas. The architecture of these networks is optimized for this environment–assuming the presence of a dedicated, high-bandwidth, highly reliable network connection, which incurs no incremental usage charge. When applications developed for these networks are deployed to large numbers of users who are not continuously connected by a high-bandwidth, highly reliable network connection, they exhibit inherent limitations that become increasingly evident as the number of users increases.

Challenges of the Mobile Environment

Those responsible for supporting mobile users within the "extended enterprise" must become acquainted with a handful of key factors which differentiate the mobile working environment.

Fixed connection LAN-based computer users typically have the use of feature-rich multimedia devices which benefit from substantial processing power, and unlimited, continuous access to information, applications, and systems and are not dependent upon battery power. They rarely have to worry about synchronizing client and server data, are locally managed and supported, and have come to expect fast, cheap, and reliable network connections.

Compare their lot to that of the mobile worker; they typically have light, small form factor, low-cost devices with limited memory, processor capacity, and battery life. These users have to deal with constrained, intermittent access to corporate systems, suffer unpredictable connection windows, and as a result need to do much of their work offline. They have to worry about how and when client and server data will be synchronized, generate complex management and support problems, and labor under slow, unreliable, and expensive connections.

Using GSM, the most widely deployed mobile data communication technology with in excess of 300 million subscribers, as an example, the maximum possible connection speed of 28.8Kbs is more than 300 times slower than the minimum of 10Mbs that is normal for a fixed connection local area network. Add to that the thought that mobile users simply do not want (and cannot afford with current billing tariffs) to be online all the time and the throughput gap widens to as much as 1:10,000.

Despite the promise of 3G telecommunications standards, and broadband wireless technologies, no one should imagine that these order-of-magnitude bandwidth limitations are going to disappear any time soon, or that the provision of faster and more reliable wireless communications will be any more cost-effective than today’s solutions.

According to Gartner Group and others, the majority of mobile users will still be connected to the enterprise at speeds that are hundreds of times slower than a LAN connection until at least 2005. They will have to remain disconnected most of the time. They will not have the luxury of calling on IS help from "down the corridor" if they have a problem. Finally, unlike the fixed connection LAN where the bandwidth is effectively "free" once the system has been installed, mobile users will be paying for every second of connect time, or packet of data they use.

Challenges Facing the Enterprise

It is clear that the management and support of mobile workers requires a new architectural approach, an approach that focuses as much on keeping them productive while they are offline as it does on providing an efficient connection when they are online. Systems administrators want to be able to manage mobile systems and applications effectively, reduce cost-of-ownership, and maximize end-user productivity.

Unfortunately, while most organizations have improved their computing resources and capabilities at their centralized sites via a mixture of client/server and intranet technologies, few have successfully implemented these systems in conjunction with the vital information flow of their mobile workers. Systems that are implemented for use by mobile workers while clinging to LAN-based assumptions have been proven to produce poor results. Applications that are straightforward to deploy in a LAN environment become more difficult to prototype, build, and deliver to large numbers of mobile users, unless the application development tools provide the applications services that these environments require. As a result, cumbersome paper-based processes are too often used to address the information management requirements of the mobile workers, to avoid the cost and complexity of developing and delivering systems designed and optimized for this unique environment.

Today's applications, built to work on PCs over a high-speed communications infrastructure, do not in general work well when applied to mobile devices over the fragile communications infrastructure which characterizes the wireless world. These demanding implementation, usability, and manageability issues threaten to constrain the growth of the mobile data and mobile commerce sector. Some innovative proprietary solutions exist, and there has recently been much effort from several industry initiatives seeking to standardize an architecture which incorporates the needs of mobile wireless devices, but too often these efforts have been focused on delivering point solutions rather than considering the global picture.

The industry has been paying attention to the increased burden of Total Cost of Ownership (TOC) for bandwidth-challenged mobile and wireless devices, Gartner Group believe that the percentage of IT budgets allocated to supporting these users will grow from less than 10% in 1998 to over 30% in the current year.

This increased cost is due to accommodating a set of requirements from enterprise wireless and mobile end-users, an insight into which was gained during The Open Group's research and interviews and the following is a sample of some common themes:

- ✓ Maximizing customer face time
- ✓ Minimizing administration and other distractions
- ✓ Having critical information to-hand and up-to-date
- ✓ Having the ability to recover critical data when a system failure or theft occurs
- ✓ Being able to connect easily from whenever and from wherever I like
- ✓ Remote support–not having to "return to base" to resolve problems
- ✓ Minimizing time wasted waiting for connections to complete

From an enterprise management point of view, the most commonly stated requirements are similar, including:

- ✓ Timely deployment of applications and their updates to wireless users
- ✓ Ensuring critical corporate information has been distributed to the appropriate users
- ✓ Having access to an accurate inventory of all hardware and software deployed
- ✓ Ensuring effective backup for all critical corporate data on wireless devices
- ✓ Providing cost-effective, remote support
- ✓ Making the most effective use of the communications budget

All of this has to be provided in the context of the more challenging mobile and wireless environment.

As a result, the architecture of fixed connection network systems does not provide a complete range of capabilities required for effective enterprise-scale wireless and mobile computing solutions. They lack the economy of operation, transparency of underlying management during a connection employing unused bandwidth, ease-of-use, and administrative flexibility required to automate core commercial business processes successfully for large numbers of wireless and mobile users.

One characteristic that all network connections have is the need for session management. That need is even more evident and pressing in an occasionally connected model. This needs to be independent of the underlying transport layer (but needs to be cognizant of it and exploit such benefits as the respective transports provide).

The importance of session management to mobile architectures was recognized by most of the individuals and companies interviewed. The feedback received during the research points to session management being a key enabler for wireless data interoperability in the enterprise environment. Considerable benefits can accrue–both to the vendor and user community–if a standard approach is established for this highly varied and complex foundation of all mobile and wireless network processes.

Characteristics of a Solution

This report posits that the functional requirements (often integrated within the logic of a particular application) of a layer to manage the session, could be abstracted to form a general, open architectural layer to support the wide range of other management services such as data synchronization, file and software distribution, accounting, security, content distribution/transformation, and so on. It is critical that the standard implemented ensures interoperability by having open external interfaces for the support of multiple applications and is agreed by all the major players in the wireless and mobile market.

The opportunity exists for The Open Group Mobile Management Forum (MMF) to accept the formidable challenge to define and gain acceptance for a common session management architecture. Why formidable? Because the MMF will have to persuade vendors to help define and agree to a standard reference model offering a protocol to support services which specifically address the unique requirements of the mobile user, as well as interoperating with existing initiatives such as Distributed Management Task Force (DMTF) and Intel's WfM (Wired for Management).

A basis for discussion by members of the MMF working on a common session management reference model could include the following characteristics.

Integrated Approach

An integrated approach is required for a complete wireless and mobile computing solution which not only spans enterprises, but allows information exchange between all members of the electronic trading community. A complete architecture must be independent of the transport layer and accommodate common transport protocols. It should offer consistent reporting of failures and allow for automated restart of a session in case of any failure. Remote control of wireless devices without a direct connection is clearly also required for remote device support. The protocol should provide a set of implementation rules that support and bridge the range and levels of application development protocols employed to build a solution.

Scalability and Control

As the market, and therefore the potential population, for wireless and mobile systems grows, the architecture must permit:

- Ease of expansion of system capacity (rapidly and economically) without forcing lock-in to a particular implementation

- Creation and deployment of applications rapidly as business requirements dictate
- Managing deployment of updates and revisions to existing applications
- Control functions to monitor and control information flow to and from disparate system users
- Minimizing operational costs by minimizing the amount of data transmitted and minimizing connection times

Ease-of-Use

The elements required to enable applications for wireless and mobile deployment should not require familiarity with particular operating characteristics and complexities of each device. Furthermore, they should shield consumers from complexities of data communications and be logically consistent with the consumers expectations of service. For example, functions that offer significant end-user transparency include sophisticated scheduling facilities (both at the server and at the wireless and mobile device) as well as a scripting facility to allow a variety of defined sequence of events with in-built logic to be defined for different sessions. To achieve transparency and shield the end-user from technical errors and communications problems, the standard should provide automated condition handling and reporting processes.

Compatibility with Existing Systems

The protocol should also offer open integration for most existing computing and communication environments in order to leverage existing customer and third-party investments in these technologies, while providing interoperability between various disparate members of a trading community. Examples are:

- Access to a range of widely-used database management systems
- Support for industry standard and product-specific application programming interfaces (such as the evolving SyncML initiative, for example)
- Adherence to Internet standards, such as mail, and so on
- Access to the variety of communications types necessitated by geographic distribution of wireless and mobile users

Communications Control

The standard reference model or framework should make it possible for solutions providers to automate and manage the exchange of information between applications and databases that reside on host systems with wireless or mobile users regardless of their location, or the wireless device type they are using.

It should provide methods for selecting, controlling, and minimizing communications, which includes:

- Central scheduling and control of communications sessions
- Provide underlying systems management transparently during a connection employing unused bandwidth
- Accommodate multiple communication alternatives
- Minimize cost and time
- Provide detailed audit trails of system communication events

Session Management Taxonomy

(… from a historical platform perspective)

To date, the principal operating systems manufacturers have all failed to embrace the full set of requirements adequately, and implement a complete architecture that serves this category of users effectively, allows interoperability, whilst giving appropriate freedom for creativity and competitive advantage, and hence consumer choice. Many suppliers are recognizing that a three-tiered model providing a (store and forward) function point between client and server to accommodate the peculiarities of the remote and mobile world is required. (This has also been referred to as a "queued architecture".)

Leading platform vendors have developed several such architectures. For example:

- IBM's Message Queue architecture comes close to achieving this aim but in the design has done nothing to improve the interoperability situation as it is proprietary and requires a significant amount of custom development.

- Microsoft came close to adopting a store and forward model in the mid nineties–until it was faced with the significant distraction of the Internet–although recently Microsoft has stated that they intend to put into the soon-to-be-announced version of CE (code-named Rapier) a version of Microsoft Message Queue Services (MSMQ) to better support distributed applications.

- As an example of the telecommunications industry wrestling with this problem, in the last couple of years Bell Communications Research has recognized aspects of the requirement above by reflecting the three-tiered architecture model in their approach to wireless mobile network computing.

The Need for an Open Standard

The ability to deliver a wide range of critical information types selectively, transparently, and effectively to the appropriate people in a timely, controlled, and reliable fashion, wherever the recipients of such information are located, and whenever they choose to connect to the host system, is a necessary component of a successful wireless and mobile implementation.

The quandary facing most corporate IT organizations with the range of offerings available today (even if they are complementary functions) is which of these independent approaches should be used as the infrastructure choice for their organization. Differences in architecture, structure, and service between the various approaches available in the market often mean incompatibility and obstacles to interoperability. This forces complexity and resulting delay as regards strategic technology selection decisions, which in turn act as a brake and an inhibitor to market growth at this critical stage of market evolution and acceptance.

The lack of architectural fluency in session management is a contributing factor to the poor reputation, which some enterprise Mobile Computing projects have acquired in recent years. As the enterprise extends the reach of its applications–beyond the relatively "safe" environs of corporate users–to include business-to-business and eventually business-to-consumer offerings, the impact is likely to be even more severe.

Conclusion and Role of The Open Group

The Open Group's Mobile Management Forum (MMF) should utilize its position with suppliers and enterprise buyers to work with the various vendors of existing management products serving enterprise use of Wireless and Mobile Computing in order to agree to a Common Session Management Layer (CSML) which would certify interoperability and compatibility of architectures.

The proposed Common Session Management Layer (CSML) should be exactly that–common to all sessions between the wireless device and its communicating partner. Herein lies the daunting complexity, as any attempt to standardize this layer needs to strike a balance between the rigors required for a standard and the flexibility to accommodate the vast range of functions and services that would need to operate on top of this layer. Beyond fairly obvious examples, such as email sessions and management functions (for example, software distribution), a broad range of e-business functions (payment, receipts, reservation confirmation, and so on) would need to interoperate with this layer.

Adoption of CSML in future releases of wireless data products would simplify the implementation choices of corporate IS departments, thus accelerating the widespread adoption of Wireless and Mobile Computing solutions, and generating continued growth for the industry.

Wireless and Mobile Application Synchronization

Overview

Computing for Wireless and Mobile devices relies on accuracy, detail, and maintaining synchronicity with multiple versions of the same data across multiple devices. As an example, mobile users coordinate their day's work with schedulers, Personal Information Managers (PIMs), and contact managers–constantly referring to a complex range of data to facilitate the day's work. As the reach of wireless and mobile systems continues beyond personal productivity tools into the realms of corporate applications, and conversely, as customer servicing corporate applications extend their reach into the Wireless and Mobile space, users increasingly trust and depend on the integrity and timeliness of data that spans the host and the various mobile platforms–a mobile phone, a handheld computer, or a laptop. Reference data on the multiple devices must be current, transferable, and reliable. A range of applications process, manipulate, and update data that the user relies on and can reference as part of their daily activities. Occasionally, users connect to the network to synchronize any local changes across the various networked devices, both submitting data and receiving updates made to the networked data while the device was disconnected. Occasionally, they may need to resolve conflicts among the updates made to the networked data.

Data synchronization is the term used to refer to this reconciliation operation where updates are exchanged and conflicts are resolved. These data synchronization activities are performed over a session management layer. Synchronizing data between these platforms is a critical element in the solutions mix to managing mobile commerce applications effectively. Inadequate attention to this dimension could cause loss of data integrity, inconsistencies in application data, and as a result impact consumer confidence, putting the brakes on acceptance of mobile commerce as a viable and necessary adjunct to 21st century business life. The absence of a single synchronization standard was identified as a major hurdle for end-users, device manufacturers, application developers, and service providers over a year ago in early groundwork leading up to the formation of the Mobile Management Forum.

Synchronization across different platform and applications sounds at first pass to be a single action to harmonize data across these platforms, but in reality it involves multiple levels of carefully defined activities to rationalize the contents of two or more sources of data (across one, two, or more platforms). This last dimension, spanning a broad range of data types across a range of operating systems, database systems, and devices, offer a significant challenge in the quest for interoperability. There is no accepted implemented standard today for addressing this need–there is a proliferation of different, proprietary data synchronization mechanisms for mobile devices. Some of these are aimed at PIM functionality and others target the deeper, more complex issue of synchronizing corporate databases. Certain solutions are only available for select transports or are implemented on a specific subset of devices.

Synchronization Taxonomy

What follows is a range of vendor solutions available in the market today to illustrate the disparate approaches and spread of solutions. Their general concept of data synchronization provides for a readily available networked, web-based repository of key information that can be accessed simply from any web or browser-based connection. Data such as calendars, address books, email, to-do lists, and so on, can be accessed "on the move" and, more importantly, kept up-to-date and synchronized with integrity by these technologies. The leading vendors in this space are aggressively moving toward a "server-centric" web-based model for synchronization of Personal Digital Assistants (PDAs) and other mobile devices. Various vendors offer the ability to connect from anywhere, over personal area networks, local area networks, and wide area networks.

A range of functions are supported, with very few suppliers spanning the full range of sample functions listed below across fixed, mobile, and wireless device families:

- Support a wide variety of mobile devices and platforms
- Provide custom content by addressing a broad range of applications, including PIMs, messaging,and group scheduling solutions, online/offline web browsers, and commercial/custom applications that provide access to mission-critical data bases (including interfacing with the proprietary mechanisms these database management systems might have for managing distributed LAN data)
- Support a myriad of wired and wireless networks over time
- Deliver mobile management tools that succeed in managing the deployment of data to wireless and mobile devices in the corporate setting
- Support multiple layers of security as defined by the system, including authentication, privacy, and data integrity
- Synchronize information quickly and reliably between wireless and mobile devices and enterprise applications

In addition to synchronization, any solution should also:

- Provide for sending time-critical messages to a wireless or mobile device urgently outside of the normal scheduled batch synchronization session
- Include the ability to query data residing on an enterprise server taking into account performance and scalability requirements
- Leverage industry standards to the extent possible, without compromising significant performance and functionality–including standards for the session management layer

Palm Computing

Palm Computing's data synchronization application, which is shipped with every Palm device, enables the user to synchronize data between those devices and desktop applications such as Symantec Corporation's Act, Novell Inc.'s GroupWise, Lotus Development Corporation's Organizer, and Microsoft's Schedule+. Palm also supplies the Conduit SDK for developing plug-ins to their facility.

WinCE ActiveSync

Microsoft's ActiveSync ships with every palm and handheld PC. Like Palm’s HotSync, ActiveSync works with a variety of PIMs (personal information managers). Visual C++ developers can create their own ActiveSync services, similar to Palm's conduits, using the Windows CE Toolkit.

Win2000 Synchronize Facility

Windows 95 and NT 4.0 featured the Briefcase, the first attempt at file synchronization in Windows. Win2000 adds a function that allows mobile users to keep data on both a PC and a network up-to-date. You can specify files or folders that are to be automatically kept concurrent, so if you lose your connection you can still work on a local copy of a file. Synchronization can be set to take place at pre-scheduled times, before logoff or shutdown, or after a certain amount of idle time.

Starfish

Starfish is a supplier of data synchronization technologies for wireless and fixed connection communication between mobile, server, and desktop devices, founded in 1994. The Starfish founding vision is: "Global synchronization and integration of wireless and fixed connection devices". Starfish has produced a variety of products such as the StarTAC Mobile Organizer and facilities for Yahoo!. Starfish supports major platforms, including PalmPilot, WinCE, and Java.

Synchrologic

Synchrologic was founded in 1995 to provide component software that addresses two key technology problems for laptop users and remote sites that goes beyond functions for synchronizing email and PIM data:

- Data synchronization–reconciling updates made to local copies of a database and keeping occasionally-connected workers updated with relevant updates
- External data access–making data from external sources (other applications' data, data warehouses, syndicated sources, ERP systems, and so on) available to remote workers

Synchrologic has the goal of being committed to providing best-of-breed technologies in specialized domains, and to produce software toolkits which solve the difficult problems associated with deferred access data synchronization and data distribution for wireless and mobile workers between handhelds, servers, and laptops.

Synchrologic sells its software to packaged applications' vendors (OEM) and to corporate developers and works closely with the major database vendors to help propagate standards and maintain integration and support for the relevant technologies The company claims that all its software strictly adheres to industry standard protocols, methodologies, and programming interfaces. They also have committed support of open-standards, and to ensure that its products integrate with them as well as the range of development tools typically employed by enterprise system developers.

Visto Corporation

Visto Corporation was founded in August 1996 with the vision of providing mobile access to personal information via the web. In October 1997, the company introduced the Visto service to mobile professionals as a "virtual briefcase" to store email, files, address book, and bookmarks. Visto offerings allow mobile workers to access vital information with a web browser when they are away from home base. They aim to provide a quick way to cull files, email, web bookmarks, and contact information from a range of PIMs and store them on Visto's secure web server for later retrieval. Visto's client software provides an organized method of synchronizing PC data with data on Visto's web site.

Visto's foundation incorporates the ability to add new applications, and levels of encryption and secure authentication, as well as the ability to access data from behind firewalls.

Scheduled synchronization and replication of data across applications is also part of the Visto architecture. Visto uses Puma PIM synchronization technology.

ITA

ITA is a provider of developer components, primarily targeted at Visual Basic developers, used for database synchronization and replication for mobile applications when they cannot be connected to a network database. They aim to provide tools that help build applications to allow people to work online as well as offline. ITA does this with Active Server and ActiveX components (based upon COM/DCOM) which provide robust functionality for database synchronization and application-to-application data exchange. The tools are based on proprietary processes and techniques.

Aether Software

Aether Software is a division of Aether Systems (formerly Riverbed Technologies) offering a software solution to extend enterprise computing access to handheld devices. Their aim is to provide mobile computing software that connects business professionals with legacy, web-based, and other enterprise software and applications.

Extended Systems

Founded in 1984, Extended Systems products include functions for data synchronization as well as network print servers, wireless infrared connections, and other network facilities.

A Standards Initiative Emerges–SyncML

SyncML (**Syn**chronization **M**ark-up **L**anguage) is a new industry initiative formed at the end of February 2000 by IBM, Lotus, Motorola, Nokia, Palm, Psion, and Starfish for developing and promoting an open universal standard for synchronizing data across different computer platforms, networks, and devices. SyncML is an XML-based data synchronization protocol supporting data synchronization (email, calendar, contact management information as well as enterprise data stored in databases, and web-based documents) while aiming to be open enough to accommodate new forms of content available in future. The SyncML Initiative is open for industry partners to join and assist in developing the specification. By mid-March more than 80 companies had signed up as members.

If engineered well, the SyncML specification should allow for interoperable wireless and wired data synchronization products across internal corporate servers, Internet web servers, personal computers and laptops, handhelds, palmtops, and other mobile devices, across platforms. The founding members of the SyncML Initiative are reported to have identified the following goals in their pursuit of a successful development and adoption of an industry-wide data synchronization standard:

- Build on existing open standards for structured data representation and industry object types
- Operate over wireless and wireline networks
- Support a variety of transport protocols
- Support arbitrary networked data
- Provide data access from a variety of applications
- Connect mobile devices regardless of platform or manufacturer
- Use existing Internet and web standards and technologies
- Provide easily accessible code for enabling support for the specification

The SyncML Initiative will build on existing standards such as XML, MIME, vCard, and iCalendar. The SyncML Initiative hopes to deliver the SyncML protocol specification later this year. This protocol aims to meet the resource constraints of mobile devices and wireless networks and will provide the extensibility to support a range of data types. The goal of the SyncML Initiative is to deliver the protocol in the future for formal adoption and maintenance by an established standards body. To enable adoption of the SyncML, the SyncML Initiative will deliver an architectural specification, two protocol specifications (SyncML representation protocol and SyncML synchronization protocol), bindings to common transport protocols, interfaces for a common programming language, and an openly available prototype implementation of the protocol.

Conclusion and Role of The Open Group

The Open Group should support the activities of the SyncML group.

The Mobile Management Forum should work closely with SyncML (and similar organizations) and the existing players in the market to ensure that the solutions fully meet the needs of users and integrate and interoperate effectively with the proposed Common Session Management Layer (CSML) work.

Furthermore, The Open Group should encourage close interaction between the Mobile Management Forum and SyncML, so that the corporate/government user community will fully appreciate and support initiatives to create an open interoperable data synchronization protocol.

Wireless Networking

Overview

Wireless Local Area Networks have brought about significant benefits for innovative companies in specific industry segments over the last couple of years. The ability to roam untethered around a working location has brought about changes in work practices with resulting efficiencies. However, due to low data rates and relatively complex deployment, wireless applications have to date been relegated to vertical niches such as warehousing, retail, and manufacturing. Using radio is no novelty to industry, but we are witnessing the emergence of newer technologies (chip-sets, adapters, access points) and standards, faster data rates coupled with voice/data integration together with license-free operation in the 2.4GHz radio frequency band making it easier for more customers to deploy and enjoy the productivity benefits of wireless operation.

The growth potential for this wireless technology is particularly interesting in the home and small business markets. In the home, and for the small businesses sector, removing the need to invest in a fixed wiring infrastructure provides cost efficiencies and flexibility, or to quote Mack Sullivan. Managing Director of the Wireless LAN Association: "Because there's no wiring, they take their system with them; they can set up the system themselves and save money on installation, too".

Factors Influencing the Growth of Wireless LAN Deployment

- Ease-of-use– (consistent) user-friendly interfaces
- Data communications
- Wireless device battery life
- Memory and storage
- Application and data synchronization
- Development tools
- Applications and solutions (end-user utility to drive acceptance)

CI estimate that in small companies with less than 5 employees, less than 6% are currently networked. For companies with less than 20 employees, only some 25% are networked and less than half the companies with 20-100 employees are networked. IDC predict an order of magnitude increase in the number of SOHO local networks over the next 3 years to 8 million. In the same timeframe (by 2002), Access Media International expect that the 20 million households that currently have 2 or more PCs will double. Frost & Sullivan forecast that for the wireless LAN market, propelled by the above drivers, over the next five years revenues will triple from the expected $400million this year, with the volume of shipments going up five-fold.

Wireless LAN Taxonomy

Genesis of the Technology

The first commercially available wireless LAN technologies appeared in the mid to late 1980s. The major requirement at first was mobility–to give employees the capability to roam with a computing device and still have connectivity to the resources available on the corporate LAN. Early implementations were in specialist industries such as warehousing, manufacturing, retail store management, and public utility environments where computing traditionally could not go and yet where significant productivity benefits were to be gained. As a result, early adopters of the technology were able to justify the cost and inconvenience of isolated implementations of proprietary technologies in discrete locations.

Wireless LANs work by superimposition of data on the radio carriers. By utilizing different frequencies, multiple users can coexist in the same radio space. In a typical deployment a transmitter/receiver (referred to as an access point) is connected to the fixed LAN or another fixed location. Wireless users then communicate with this access point (AP) using wireless adapter cards on their wireless information device (WID). This communication is transparent to the LAN operating system. Access points have a range of approximately 150 meters indoors and 300 meters outdoors. The aim is to position access points so that clients might roam freely without losing network contact. Multiple access

points can exist to hand the client off from one to another transparent to the client. Similarly, designers may employ an extension point (EP) to extend the reach of a network. An EP differs from an AP in that it is not connected to the fixed network, but in other respects functions like an AP.

The Drive for Enterprise Wireless LAN Standards

As with any new technology, there emerged a few competing and independent proprietary wireless LAN (WLAN) approaches forcing the early adopter community to choose a single vendor technology, and commit to it throughout their corporate deployment. There was also a drive to establish a standard to allow interoperability between various manufacturers' WLAN implementations. The early end-users of WLANs were seeking to influence the vendor community to improve the speed and reliability of wireless LANs to approaching that which is experienced on fixed connection LANs. As a result, the Institute of Electrical and Electronics Engineers (IEEE) was given a mandate to develop a standard for spread spectrum wireless LANs operating in the unlicensed 2.4GHz Industrial Scientific & Medical band. This work was undertaken by the LAN Interoperability Group IEEE 802.

In 1997 the original 802.11 standard for 2.4GHz wireless networks was delivered, with feedback from some sectors of the industry that it had done little to promote interoperability among products from competing vendors as it allows for both frequency-hopping and direct-sequence-spread spectrum-based radios; two incompatible technologies. The standards also failed to deliver the framework for the required speed improvements as it only allows for low data rates (2 Mbits or less) which proved too noticeable a gap between this and the performance to which a typical Ethernet LAN user had become accustomed. Nevertheless, 802.11 products based on Ethernet LAN protocols are now freely available, and are being implemented in corporate networking infrastructure.

In 1991 ETSI (the European Telecommunications Standards Institute) began work on the definition of HIPERLAN/1, a high performance LAN which operates at a higher frequency than 802.11 in the 5.15GHz to 5.25GHz band. The standard was delivered in 1996 and like 802.11 it too is an implementation of Ethernet LAN protocols, but provides greatly superior maximum air interface speed of 23.5 Mbits delivering usable data rates of up to 18Mbits at a range of 50 meters. The issues of quality of service are also addressed in this standard.

Factors End-Users Consider When Deploying Wireless LANs

- Budget
- Security and reliability
- Desired throughput
- Compatibility and interoperability of wireless devices and the fixed (LAN) infrastructure
- Environmental interference
- Usability/simplicity
- Scalability
- Licensing issues (for certain global deployments)
- Desired range and coverage

The IEEE responded with the 802.11 HR (High Rate) DSSS offering a standard which allows industry compliance for 11 Mbps in the 2.4GHz radio frequency band. This allows wireless LANs to be extensions of 10 and 100 Mbps wired Ethernet networks. IEEE 802.11 has emerged as a key element of a new service model taking a step further towards the convergence between the Internet, voice, and data, allowing services and communication constructs to be built where the user is an active and constant participant in the communication space.

Meanwhile the work of ETSI has progressed and HIPERLAN/2 is intended to provide access to IP, ATM, and 3rd Generation mobile networks. As opposed to IEEE 802.11 and HiperLAN1 which were based on wireless Ethernet technology, HIPERLAN/2 is connection-oriented with wireless connections being time-division multiplexed, and as such, aims to provide common connectivity for mobile communications in corporate, public environments, and home to ensure the production of interoperable products.

Close co-operation has been developed by ETSI with the IEEE 802.11 committee and the Multimedia Mobile Access Communications Promotion Council (MMAC) in Japan, which led to agreement on a common standard and approach for worldwide spectrum allocation.

New Approaches for New Markets

Computer and telecommunications technologies that are proven in commercial settings are rapidly absorbed into other markets. Wireless LAN technology is no different with residential and personal area network offerings being introduced. Sometimes a new approach is justified in order to simplify implementation and administration overhead, but often a simplified or reduced functionality implementation would serve a similar purpose.

Residential and SOHO Market

In the late 1990s, a consortium known as the HomeRF working group was formed to focus on creating a shared wireless access protocol (SWAP) for interconnecting data and voice equipment in the home environment. This area was already being addressed by the European Digital Enhanced Cordless Telecommunications (DECT) standard, a Time Division Multiple Access (TDMA) structure which although not specifically aimed at residential use, allows for full-duplex data communications at 552kbps, and was designed to permit short range access to voice, fax, data services via wireless LAN, and wireless PBX services.

The HomeRF definition which offers support for 127 devices and six full-duplex conversations per network, uses 2.4GHz FHSS technology, is compliant with ETS300 328, and compatible with IEEE 802.11. As a result it may offer a useful low-cost alternative for shared, high speed Internet access solutions. HomeRF has also ensured a level of compatibility with DECT, part of the IMT2000 specification which has so far achieved widespread implementation in digital cordless telephones.

Meanwhile the ETSI backed DECT has recently released standards for approval which have important implications for low-cost technology for high-speed data transmission in the 50-300 meters range. One of these, DECT Packet Radio Service (DPRS), is intended to be the basis for all interoperable packet radio services that can be offered over the DECT air interface. Embracing the deployment of home, small office, enterprise, and public services it is proposed as the base standard for simultaneous operation of voice and high speed data transfer in the same mobile terminal. With over 200 products on the market, a total of nearly 45 million terminals delivered by the end of 1999, adoption in 110 countries, recent acceptance as a WAP carrier, and adoption in the U.S. on the 2.4GHz band under the name of Personal Wireless Telecommunications, it is interesting to see how DECT's use in the domestic WLAN market will develop.

We are beginning to see the proliferation of other low-cost residential WLAN networks based on proprietary 2.4GHz protocols, and a lack of product interoperability seems inevitable, giving the residential customer integration challenges which they are not expecting, and almost certainly not equipped to resolve.

Personal Area Network (PAN)

A few years ago, the telecommunications and computing industries recognized that a truly low-cost, low-power radio-based cable replacement, or wireless link, was desirable to provide the basis for small portable devices to communicate together in an *ad-hoc* fashion.

A study was performed, and the technology code named "Bluetooth" began to be defined. The goal was to enable an easy-to-use service for mobile and business users by means of a small, short range radio-based technology for integration into production line models of a range of different devices, or in other words a small form factor, low-cost, short range radio link between mobile PCs, mobile phones, and other portable devices to provide a cost-effective solution for the replacement of the many proprietary cables that connect one device to another.

Bluetooth is an open specification for wireless communication of data and voice. It is based on a 9 x 9mm microchip, facilitating protected *ad hoc* connections for stationary and mobile communication environments. In addition to a hardware description, it also offers an application framework and interface support with interoperability requirements.

For instance, Bluetooth radio technology built into both the cellular telephone and the laptop would replace the cable used today to connect a laptop to a cellular telephone. Printers, PDAs, desktops, fax machines, keyboards, joysticks, and virtually any other digital device can be part of the Bluetooth system. But beyond removing the tethers from devices by replacing the cables, Bluetooth radio technology employs FHSS and provides a universal bridge to existing data networks, a peripheral interface, and a mechanism to form small private *ad hoc* groupings of connected devices away from fixed network infrastructures.

The Bluetooth world refers to a piconet as a collection of devices connected via Bluetooth technology in an *ad hoc* fashion. A piconet starts with two connected devices, such as a portable PC and cellular phone, and may grow to seven connected devices. All Bluetooth devices are peer units and have identical implementations. However, when establishing a piconet, one unit will act as a master and the other(s) as slave(s) for the duration of the piconet connection.

In addition to the significant weight of the founder members–Erricson, IBM, Intel, Nokia, Toshiba–Bluetooth has snowballed in popularity and has over 1000 adopters in the industry stewarded by a special interest group (SIG).

The working group IEEE 802.15 resulted from a study group within 802.11 that produced a draft project authorization request for wireless personal area networks to be discussed. The study group has solicited industry input on market requirements and technical solutions for a wireless personal area network (WPAN) with 0 to 10 meter range, data rates of less than 1Mbit/s, low power consumption, small size less than 0.5 cubic inches, and low cost relative to target device. Sectors of our industry are wrestling with the potential overlaps and conflicts between the implementation of Bluetooth and the IEEE work.

Other Specifications Relevant to this Space

The **IEEE Wearable Computers** activities are peripheral to the wireless LAN space. Worn on the body, they provide constant access to computing and communications resources. Wearable computers are defined as unobtrusive computing devices, networking devices, software, and peripherals, which are worn or carried by individuals and enhance their ability to perform productive work as well as provide entertainment. Input devices for wearables range from innovative text input devices, video capture devices, microphones, GPS locators, affective sensors (blood pressure, GSR, heart beat, EMG), infrared positional beacons and probes, digital cellular modems, PDAs, and so on. Output devices include head-mounted displays, speakers/headsets, PDAs, tactile feedback, speech, and so on.

IAPP (Inter-Access Point Protocol) is a specification that defines how access points from different vendors in an IEEE environment communicate with each other to support roaming. The IAPP specification defines how access points will communicate to hand over mobile stations. This specification provides interoperability when used with IEEE 802.11. It is sponsored by Lucent, Aironet, and Digital Ocean who expect that it will spur the development of products compatible with IAPP to achieve wireless LAN interoperability. The IAPP specification builds on the capabilities of IEEE 802.11 that address the physical and media access control layers of the OSI reference model–the IAPP specification on the other hand tackles higher-level OSI layers such as logical link control to achieve inter-access point communications. In addition to the three sponsors, IBM have also indicated their support for IAPP.

Firewire is another IEEE standard relevant to this world–IEEE 1394. It offers multimedia connection enabling simple, low-cost, high-bandwidth realtime (isochronous) data interfacing between computers, peripherals, and consumer electronics products such as camcorders, VCRs, printers, PCs, TVs, and digital cameras. The attributes of multimedia orientation, self-configurability, peer-to-peer connectivity, and performance of 1394 have encouraged applications that include non-linear (digital) video presentation and editing, desktop and commercial publishing, document imaging, home multimedia, and personal computing. The low overhead, high data rates of 1394, the ability to mix realtime and asynchronous data on a single connection, and the ability to mix low-speed and high-speed devices on the same network provides a range of benefits to the world of wearable computing.

Industry Groups that Focus on the Wireless LAN

Wireless Ethernet Compatibility Alliance (WECA)

The Wireless Ethernet Compatibility Alliance was founded on August 23rd 1999 by six major players in the wireless market–3Com, Aironet, Intersil (formerly Harris Semiconductor), Lucent Technologies, Nokia, and Symbol Technologies–to certify and promote multi-vendor interoperability of wireless LAN systems.

WECA's goal is to certify interoperability of IEEE 802.11 high-rate products and promote that standard for SMEs (small to medium enterprises) and the home. Over the past several months, WECA has worked closely with Silicon Valley Network Labs (SVNL) to develop an interoperability test bed. This task was completed in February 2000 and interoperability testing is now underway with SVNL operating as an independent test facility. However, only WECA members can submit products to the lab for interoperability testing. When a product meets the interoperability requirements as described in the test matrix, SVNL notifies WECA, which then grants a certification of interoperability, which allows the vendor to use the Wi-Fi logo on advertizing and packaging for the certified product. The Wi-Fi seal of approval assures the end customer of interoperability with other network cards and access points which also bear the Wi-Fi logo.

Wireless LAN Association (WLANA)

The Wireless LAN Alliance, also known as WLANA, is a non-profit trade association with a declared educational focus, made up of leading local area wireless technology vendors. WLANA provides information about wireless local area networking applications, issues, future directions, and trends, offering a reference resource to customers, press, and analysts. Information available includes industry studies, white papers, application stories, and links to related topics and member web sites. As an example, at the end of 1998 WLANA commissioned a study to research the ROI gained from the implementation of wireless LANs in five industries, with an executive summary of the results available on the WLANA web site. The study indicated a high level of satisfaction with the investment customers, with average payback quoted as less than 9 months.

In addition, the Alliance provides an industry voice to government agencies and third-party vendors. WLANA is committed to establishing wireless LANs as a key component of future local area network technology.

Early in 1999 WLANA announced that it had broadened the scope of its educational efforts to include all forms of local wireless applications and technologies, including personal area networks (PANs) and home radio-frequency networks (HomeRF and Bluetooth) as a response to perceived market needs. Jeff Abramowitz, WLANA President, was quoted as seeing the $450 million local wireless segment of the industry as about to cross the chasm into three broad segments: general-purpose enterprise applications, home networking applications, and ubiquitous personal area connectivity.

In the last few months WLANA has been active in the debate around the NPRM in which the FCC proposes to amend the Part 15 rules regarding the rules that govern FHSS systems operating in the 2.4GHz band. In addition, the FCC is attempting to refine measuring the processing gain of DSSS systems operating in the 2.4GHz ISM band.

The WLANA is opposing the changes to the FHSS rules to curb multiple standard confusion in the wireless market. The IEEE 802.11 committee has established a standard for high data rate (HDR) operation to allow DSSS systems to achieve data rates up to 11Mb/s. The WLANA is trying to dissuade the FCC from expanding the FHSS in an attempt to promote the acceptance of a single standard for high-speed operation. The FCC expects to determine its action on these rules by early 2000.

Wireless LANs Research Laboratory (WLRL)

In the academic world, the Wireless LANs Research Laboratory was established within the Center for Wireless Information Network Studies (CWINS) at the Worcester Polytechnic Institute, in Massachusetts, U.S. The key objectives of the WLRL are to serve as a focal point for wireless LAN technology including issues involving benchmarking and performance, to specify and develop key benchmark criteria and test software, including compatibility, interoperability, and standards verification software and systems. This includes designing and developing installation planning, simulation, and debugging tools for both hardware and software. They publish their output as articles, presentations, conferences, and on the Internet.

Wireless Information Networks Forum (WINForum)

The Wireless Information Networks Forum is an association for manufacturers of unlicensed communication systems, including PCS products. WINForum's membership includes Lucent, Nokia, Hewlett-Packard, Apple Computer, Ericsson, IBM, Motorola, NorTel, and Rockwell. WINForum was active in its FCC efforts with the allocation of 300MHz of spectrum in 5GHz band called the Unlicensed National Information Infrastructure (U-NII) bands by the FCC within the ranges 5150 to 5350MHz and 5725 to 5825MHz. (ISM users also occupy the latter band.) WINForum's work with the FCC is ongoing with the finalization of U-NII bands exclusively for high-speed multi-media services and to lock out these bands for other purposes such as low data rate applications.

Wireless Interoperability Forum (WLI Forum)

The Wireless Interoperability Forum (WLI Forum) member companies span a number of mobile computing product and service suppliers focused on the interoperability of a wide range of wireless LAN products and services to foster the expansion of this market. They have published an open interface specification enabling independent parties to develop compatible products, and have established a certification process for wireless LAN product interoperability, including opening existing interfaces, defining and executing interoperability tests, and increasing market awareness.

Their charter is not intended to conflict with the IEEE 802.11 objective of developing new interface specifications. They intend to develop a transition path to new standards as they emerge, including 802.11 in the 2.4GHz band and other open standards in different bands from the current RangeLAN2-based interface. The RangeLAN2 RF wireless LAN technology was introduced in 1994. It is a 2.4GHz FHSS architecture that operates at a data rate of 1.6Mbps per channel, with 15 independent channels, or hopping pattern, available that allows up to 15*1.6Mbps independent wireless LANs to operate in the same physical space, providing up to 24Mbps of aggregate network bandwidth. The additional bandwidth is critical in maintaining high throughput for each user even when there are a large number of users.

HIPERLAN/2 Global Forum

HIPERLAN/2 Global Forum is an open industry forum which was formed in the third quarter of 1999 with the objective of providing common connectivity for mobile communications in corporate and public environments and in the home. Founding members, Bosch, Dell, Ericsson, Nokia, Telia, and Texas Instruments formed this consortium to promote the HiperLAN2 standard worldwide, and to ensure interoperable products are produced against the standard.

Current Implementation Issues

The industry is seeing the major players setting out their stalls for the current and emerging standards in wireless LAN technology. As we have seen from the taxonomy above, the predominant use in wireless LANs is spread-spectrum technology. Even though there are many standards bodies and affinity groups in operation, our canvassing showed that there remain in the market concerns over divergence of wireless LAN standards and development activities which will threaten the interoperability of, and investment in, wireless LAN products.

We document below the issues voiced by those we canvassed which are seen by end-users as barriers to purchase and deployment, or by vendors as inhibitors to the growth of the WLAN industry, and the widespread adoption of the technology.

Incompatible Protocols

Spread-spectrum technology is a wideband radio frequency technique that transmits a message on different frequencies that are reassembled by the receiver, technology already in use, as an example, by GPS systems and CDMA telephones. Spread-spectrum improves reliability and security by reducing interference among users sharing a common spectrum. The two most typically in use are FHSS (Frequency-Hopping Spread Spectrum) and DSSS (Direct-Sequence Spread Spectrum). FHSS appears as a single logical channel by using a narrow-band carrier that changes frequency in a pattern known by both transmitter and receiver. DSSS generates a bit pattern called a chipping code in which data is combined with a pseudo-random digital sequence (PRN) which is demodulated by a similar technique employed in the receiver.

Here is the rub–FHSS and DSSS do not interoperate. So what are their relative strengths? FHSS claims scalability as a strength–it is easier for multiple uncoordinated FHSS networks to be co-located (think of Bluetooth). DSSS claims greater range with QPSK/BPSK modulation being more efficient than FSK with a higher data rate (today 11Mbps to FHSS 2Mbps). The FCC is considering a rule change as a result of NPRM 99-231 (notice of proposed rule making) with a final result expected early in 2000. The NPRM addresses DSSS certification procedures and FHSS channel widths. IEEE 802.11 HR will comply with the proposed rule changes. For FHSS, the wider bandwidth would allow increased data rates with an adverse impact on scalability and interference due to the requirement for overlapping channels with a higher hop rate. But this party is not over yet–there is still time for some intense debate before a conclusion is reached.

Lack of Conformance Testing and Certification for WLAN Standards

Until very recently (February 2000), even within what is purportedly a well-defined standard, end-user organizations have experienced issues resulting from a lack of conformance and certification testing program for 802.11 HR equipment. End-users have been frustrated by the lack of guarantees of interoperability even when they take pains to ensure that equipment purchased from competing vendors is based on a common chip-set. This is seen by end-user organizations as a major failing in the deployment of standards. The recent work announced by WECA should go some way to solving the issue for 802.11HR equipment developed by its members, but an industry-neutral conformance testing and certification infrastructure must be implemented for all wireless networking technologies including Bluetooth, HIPERLAN (1&2), and HomeRF.

Frequency Interference

There is a multiplicity of WLAN technologies being allocated spectrum within the 2.4GHz band. These include IEEE802.11, Bluetooth, DECT, and HomeRF.

HIPERLAN has the potential to interfere with satellite systems operating in the same 5GHz spectrum. To avoid any short-term interference, the HIPERLAN/2 standard states that the transmitter power will be reduced from its current 1 watt to 200mW in parts of the band where conflicts are prone to occur. A longer-term solution is to make more of the 5GHz spectrum available and there are currently public consultation processes in place in most countries.

General consensus among the user community to which we spoke was that they wanted to see some co-ordination between divergent WLAN standards and one worldwide 5Ghtz approach.

Many of the end-user organizations we interviewed were of the opinion that HomeRF is overlooking a basic human behavior dynamic which will threaten its success. Many of the early adopters of WLAN technology in the home will be the same people who have become accustomed to using it in the workplace. Workers that bring their laptop home with them will fully expect it to interoperate with any

WLAN technology they implement in their home environment. Early experiences show that observance of IEEE 802.11 is not sufficient to guarantee this and, since the corporate standards are likely to prevail, residential users will be prepared to pay a premium for peace of mind.

Lack of User and Device Profiling Capability

Bluetooth continues to be developed successfully, but feedback from the industry raises concern that the group is not paying enough attention to the important topic of user and device profiling, and the need for a directory which is capable of storing multiple profiles for each device depending on their current mode (work/home/travel/recreation). The Bluetooth SIG should be encourages to work with an organization already well versed in the definition and deployment of directories.

Conclusion and the Role of The Open Group

What is required to foster uninhibited growth of the high-speed wireless connectivity market? At minimum the smooth coexistence, and at best the highest possible level of interoperability between Bluetooth and IEEE 802.11 and .15, which requires the oil and water mix of FHSS and DSSS.

Industry effort is required to achieve alignment of activities in WECA, WLANA, HomeRF, and so on, to ensure that differences do not retard market growth, and conformance and certification testing programs are implemented to ensure end-user confidence. The Open Group can leverage both its conformance and certifications program skills and the power of its corporate and government buyers to promote a common industry consensus.

Wireless Device-Independent Content Origination

Overview

Internet content and services have to date been targeted at a *de facto* standard presentation device, a desktop computer. Regardless of differences within operating systems, browser technology, and version, the base-level content has been created in a uniform fashion and to a known and constant set of base requirements.

When looking to extend the Internet to the wireless world one is faced with a discontinuity and a range of mark-up languages and protocols for rendering Internet content on the range of form factors for wireless devices. As a result, the majority of the content that exists, aimed at the PCs form factor, is unsuitable for, and unable to be displayed upon, the full range and form factor of devices available.

WAP–The "First-to-Market" Standard

The Wireless Application Protocol (WAP) is becoming the *de facto* world standard for wireless information and telephony services on digital mobile phones and other wireless terminals. It is optimized for small devices and is based on the Internet client/server architecture. WAP introduces a wireless-optimized mark-up language, WML, which is a subset of HTML, but introduces new syntax. As a result, all content and applications must be supplemented with (or even rewritten to include) WML notation before the content can be delivered to the consumer. Thus, WAP only provides "Internet-like" access to information.

By contrast, in Japan, NTT DoCoMo's i-mode (see box) technology actually is the Internet delivered over the IP protocol stack to the handset. HTML content intended for display on the handset requires only the addition of a few new commands which are specific to the navigation mechanism used. i-mode does not require special servers or gateways–or major rework of the existing web content–to be available to customers. The growth of the i-mode web sites is due to the ease for individuals to generate the markup language (Compact HTML) from standard web authoring packages.

I-Mode

In February 1999 NTT DoCoMo, Japan's biggest mobile phone company, released i-mode, a mobile phone that allows subscribers to surf the Internet as well as make calls. People are already using the phone to check the news headlines, follow the stock market, and download the latest jokes. Since launch, independent service providers have been developing (and making money from) mobile e-commerce sites specifically to allow i-mode users to buy cinema tickets and manage their bank accounts.

The service launched with 67 application alliance partners which had links from the i-mode portal page, 7 search engines had developed interfaces for i-mode Internet web sites and thousands of voluntary i-mode web sites have been created by Internet subscribers and other organiations–all of which can be accessed directly by entering a URL. These partnerships have enabled the company to release services focused on the entertainment market. These include mobile Karaoke and "Chara-Pa" (virtual friends)–graphical representations of cartoon characters which the user can download for ¥100 per year. As at August 99 there were already 130,000 subscribers to this seemingly frivolous service netting its supplier, Bandai Corporation, ¥13m per year, of which NTT DoCoMo nets a 9% commission.

Six months after launch i-mode had 1,081,841 subscribers., and enjoys a 12,000 to 14,000 daily increase. The company achieved its target to acquire 4 million by the end of March 2000. The average monthly user spend for connection and data-packet transmission charges is US$12-15 which means when they hit their target NTT DoCoMo will be reporting base subscription revenues in the order of US$48m per month.

The commercial success of i-mode will lead to smooth introduction of IMT-2000 which will enable 64k-384kbps, high-speed access from mobile devices unleashing the possibility of delivering more services.

WAP has made significant progress since its inception in moving toward being an open standard, but certain obstacles still exist for an enterprise customer seeking to gain interoperability across various device types and across various implementations of WAP servers. Although initial work by the WAP Forum did not address certain issues (including security and interoperability), in sufficient depth for the broader user community to be confident of the outcome. The Open Group is already working closely with the WAP Forum working groups to address these shortcomings.

Despite the best efforts of the WAP Forum, traditional PC web content providers are faced with the daunting task of re-engineering their content so as to be able to meet the specifications of the WAP standard. Even if the human resources were available (at any price) the overhead this represents–particularly for the presentation of realtime data feeds–is quite costly, and feedback from one content provider suggested an unwillingness to accept the cost involved. This has created an opportunity for, and led to the creation of, wireless-specific portals and content providers who are scrambling to grab their share of the market before the giants can re-orient themselves.

In addition to the efforts within the WAP Forum, content translation and transformation engines are being developed to interactively overcome the quirks and inadequacies of various wireless devices. An example of this is U.K.-based Argo Interactive Group which is developing "web-to-WAP" software called ActiGate which, when used in conjunction with a custom-defined template, will perform the necessary translation in realtime.

Industry Convergence Forces Open Standards

The WAP Forum has further recognized that the WAP standard cannot exist in isolation from the "rest" of the Internet, and there is a visible agenda within WAP toward removing some of the proprietary approaches which were implemented as "necessary evil" in early releases to overcome limitations in the network and client technology. Indeed the ETSI-backed Mobile Execution Environment (MExE) definition has adopted WAP specifications as Classmark 1, with Classmark 2 clearly signalled as Open Standards including Java, IP, and use of common mark-up language. Recognizing the need to closely coordinate with the Internet community, the WAP Forum has signed a mutual cooperation agreement with W3C to ensure that the work between the two organizations is complementary in nature and enables seamless extension of Internet developments to the wireless environment.

The Challenge of Device-Independent Content

The challenge posed by WAP is merely one example of a much more general problem which faces information providers. It may be acceptable to have specific point solutions to translate from standard HTML to WML for WAP, but this solution is not scaleable as the number of different device types and form factors proliferates. It is simply not possible for information providers to be aware of the specific characteristics of every kind of access device.

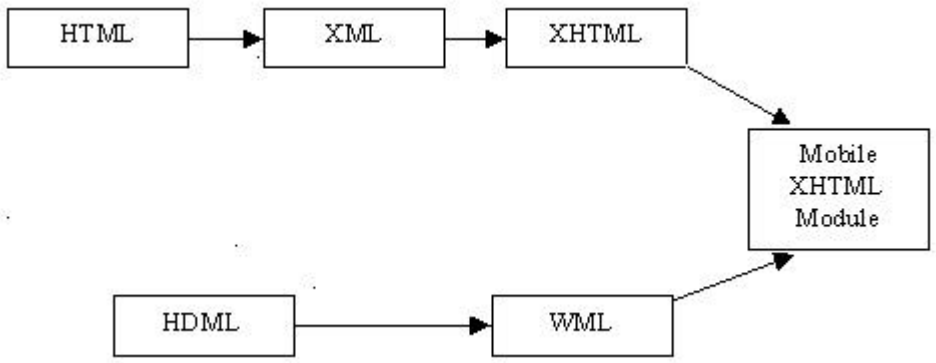
The holy grail for content providers is to achieve independence of platform, language, and media. Two complementary approaches are currently evolving.

A standards-based approach from W3C, referred to as XHTML, includes facilities to profile both the original content "page" and the characteristics of the device. A single version of the original information is translated either by the server or browser for display on the specific device.

XHTML is an evolution of HTML which exploits the strengths of XML. XML developed within W3C is effectively a language which allows the rigorous definition of languages for information interchange.

HTML and WML can both be viewed as "first generation" mark-up languages, primarily addressing the rendition of information. XML-based languages go further and allow the semantics of the information to be defined. XHTML is designed to be both human-readable and computer-processable.

There is a clear convergence path from both HTML and WML towards XHTML.



Planned Convergence of Mark-Up Languages

The second approach involves the introduction of policy-based intermediation systems, such as the recently announced WebSphere Transcoding Publisher from IBM. Such systems can and do utilize XHTML to profile content and devices, but are capable of much more, including protocol conversion and content filtering.

In rounding off this section, as often happens in our industry, Microsoft launched an alternate initiative with similar aims called BizTalk. It did this with the support of many enterprise resource planning (ERP) and e-commerce software vendors and service providers.

Conclusion and the Role of The Open Group

The Open Group should continue its close cooperation and support for the WAP Forum by delivering interoperability test suites and building a world-class certification program. As appropriate, The Open Group should try to bring to the attention of WAP members other initiatives which impact on the WAP standard, and will strongly encourage convergence with XHTML.

The Open Group should use its existing relationships with the suppliers of intermediation technology to ensure full integration with XHTML and common definition of extended transcoding rules.

The use of XML is evolving at web speed, driven in part by the growth of the wireless and mobile market. While the definition of XML itself is centralized and carried out within W3C, the definition of schemas, which define specific XML-based languages, is a distributed activity, being carried out by groups that understand the semantics of the information involved.

The Open Group is already a forum where industry groups are working on XML schemas for information exchange; this activity should be extended to handle the specific requirements and characteristics of wireless devices and mobility, working with other groups such as those above and OAG, OBI, OTP, OFX, and so on.

Authentication, Authorization and Accounting

Overview

Being able to connect any computing device to any other irrespective of location is a blessing coupled with security pitfalls. For an individual, free access to any resources on the Internet is enormously powerful. For anyone concerned with corporate security it is a major headache, exposing the trove of corporate confidential information assets, both to unauthorized access and potential misuse, as well as exposure to viruses, works, and other digital pollution.

The Internet has recently seen the proliferation of mobility. In the past because of the high preponderance of desktop computers, only a few pioneers were exploring the possibilities and challenges associated with allowing users to be connected to (and from) different places in the network as they move with their terminals. The spreading market acceptance of portable computers and mobile wireless devices have made it possible to be truly location-independent and extend the network to the home, hotel, remote office, construction site, vehicle, or any other place outside of the centralized LAN environment. The fact that the users can now be connected to, and roam dynamically between, different points in the network breaks one of the most important assumptions in the Internet protocol, which is that the IP address and the physical location of the user are always the same.

New Requirements for Security

One of the principal obstructions which will arise for these mobile devices is already evident in today's implementation of most corporate security systems–that of access control. Anyone who has travelled with their PC to a sister office and has attempted to link back to their home domain has likely experienced difficulties in accessing their "home" resources.

If a remote LAN is connected to the Internet it is almost certainly protected by a firewall (this is a device which limits the access of unknown visitor devices to LAN-based resources). The identification for access control and authority is normally the IP address of the calling device. Thus, the firewall for a corporate LAN is normally configured to only permit external access by devices which have an IP address which is within a predefined range, or has been uniquely registered. Where the device is one which is normally used within the LAN, and is calling in via some form of Remote LAN Access (RLA) technology, the firewall will identify it correctly and thus grant access to the device. If the same device attempts to establish a connection across the public Internet via an ISP, then it will normally inherit a new IP address–allocated by the ISP for the duration of the session–and thus look like a foreign and potentially unwelcome visitor.

The situation is similar upon arrival of the mobile device at a remote site. In this instance the device is allocated a new IP identity within the subnet in order for it to be accepted by, and receive network services from, the local routers and devices within the subnet. If the device were to attempt to use its "primary" or "home" IP address, these would not be available without prior specific configuration of the firewall, neither would access out via the public Internet.

This situation is further complicated by mobile devices which will exist within an IP subnet only for as long as they are in transmission range of the subnet. Firewalls therefore need to become a good deal more sophisticated in their recognition of mobile devices, if the user is to obtain a consistent access and service experience in accordance with their AAA (Authentication (who am I), Authorization (what am I allowed to do), and Accounting (how do you charge me for it)) profile, regardless of their location.

There is much work currently underway in the Internet Engineering Task Force (IETF) to define the AAA requirements of Mobile IP. An IETF working group was formulated to work on a solution to this problem. Its main goals in the interest of a workable solution are:

- Each mobile host must be able to use its home IP address anywhere.

- Software changes to fixed hosts are not permitted.
- Changes to the router software and tables are not permitted.
- As far as possible, packets for mobile hosts should not make any detours on the way.
- No overhead should be incurred when the mobile host is at home.

Convergence of Two Industries

Many in the telecommunications industry see the IETF work as a duplication of effort. Cellular network operators have been able to authorize, authenticate, and account (bill) for voice call roaming for nearly a decade, and GSM data services, such as SMS, are already enabled for roaming across national boundaries with all the inter-network and customer billing taken care of within the infrastructure of the network.

In the telecommunications world, standards are enforced by regulation; however, in the Internet world, standards exist through consensus implementation. As mentioned previously in the Content Provision section, MWIF has been established by industry players to bridge the old world of billing and customer service across into the new, IP-based world.

This leads into the second major consideration for support of mobile users, which is the provision of the new multimedia applications containing voice and video over IP. This "revolution" has been created because of the high speed of processors, together with the promise of UMTS and other 3G standards, enabling the construction of very sophisticated desktop, laptop, and handheld mobile devices, together with the availability of networked multimedia applications. However, the Internet was originally designed and built to handle data flows exclusively in a "best effort way", with no warranties of minimum throughput and delay end-to-end. For video and voice applications to work adequately, the network needs to provide a minimum bandwidth and delay along the path to transmit those flows correctly.

The networks have recognized and anticipated the growth of the mobile data revenues they will soon be able to make, but this is only on the transportation of the data, which compared to the value of the data and transactions they will be carrying, is small beer indeed. Analyst estimates of the annual value of consumer goods and services transacted over mobile networks by 2003 vary between $8billion and $13 billion.

However, there are many barriers to m-commerce happening. The global reach of the technology hits local legal and cultural hurdles which make worldwide standards in commercial rules and best practices difficult to achieve. Telecommunications companies are familiar with doing business globally and as a result all the Wireless Network Operators are keen to raise their role above that of the "bit carrier" and participate centrally in the provision and completion of all of their customers' m-commerce transactions.

Telecommunication billing systems are already equipped to carry out most of the AAA work required for routing traffic and completing a secure transaction. As a result, mobile network operators could soon be able to provide a whole new range of payment schemes for goods bought via mobile devices hosted on their network. However, this assumes the merchant at the other end of the transaction is prepared to use the network's billing system.

And here is the problem: Who “owns” the customer?

Up until now it has been the network operator which “owned” the relationship with the mobile device user through the air-time contract. Subscriber identity is associated with the device in this model. But once IP is delivered to the handset (GPRS should deliver this within 2000) then the network operator's role within m-commerce can be likened to that of the average ISP, purely providing the transport for a nominal subscription fee and charge per packet. An end-to-end m-commerce transaction can take place without the network being aware of it.

Mobile network operators are thus faced with two main problems: how to provide the full range of AAA services for IP-based m-commerce, and how to work with vendors and service providers to offer the AAA capabilities of security and micro-payment while not damaging their relationship with banks and credit card companies which are providing these services for the fixed-connection Internet.

Another example of convergence can be seen in the groundwork currently underway for the roll-out of GPRS and EDGE, packet-based 2.5 generation global cellular standards. Wireless and cellular networks are moving to a purer IP-based world, thereby laying the foundation for more open standards and greater interoperability. Early in 2000 a group of service providers and suppliers formed the Mobile Wireless Internet Forum (MWIF), a forum focused on accelerating the deployment of open, Internet-based standards for mobile wireless networks.

MWIF aims to provide a forum to identify and resolve issues surrounding the development of key specifications based on IP wireless networks, independent of air interface, to enable seamless integration between mobile telephony and other IP-based services such as data, voice, video, and multimedia. The first goal is to produce a reference architecture that supports open interfaces across access technologies through a common IP core, and a distributed, peer-level scalable IP-based architecture that includes IP standard interfaces for billing and customer service.

Specifications developed by MWIF will be available to traditional standards bodies and other industry groups. MWIF also works to ensure that key regional and global standards groups address requirements that operators globally see as critical to early and economic deployment of IP mobile wireless networks. This focus forms a basis for the issues of content distribution from the traditional Internet and the wireless and mobile world.

Requirements for Secure Transactions

There are four different concerns that a security system can address: privacy, integrity, authentication, and non-repudiation.

Privacy: Ensures that only the sender and the intended recipient of an encrypted message can read the contents of that message.

Integrity: Ensures the detection of any change in the content of a message between the time it is sent and the time it is received.

Authentication: Ensures that all parties in a communication are who they claim to be.

Non-repudiation: Provides a method to guarantee that a party to a transaction cannot falsely claim that they did not participate in that transaction.

Whatever security is provided for mobile commerce, there needs to be some level of positive interaction between the user and the device. Although an offline PIN can be stored, it must be the user that initiates its submission.

Over the Internet, the Secure Socket Layer (SSL) protocol, digital certificates, and either user name/password pairs or digital signatures are used together to provide all four types of security.

Digital signatures are indispensable for making electronic communications legally binding. In comparison with other authentication techniques, those using one-time only passwords (PIN process) have proven themselves extremely cumbersome. Furthermore, they do not offer any real security for the transaction content because there is no association between the PIN and the message.

The need for an alternative model for mobile phone usage is best understood by revisiting the differences between the fixed connection and wireless Internet environments. The fixed connection world assumes that the client device has robust processing capabilities and the communications interface is always on, always connected, and has at its disposal high bandwidth at low latency. The

very nature of wireless communications is almost the reverse where bandwidth is low, costly, has high latency, and is unpredictable and of variable quality, even to the point call breakdown.

As with many aspects of the deployment of mobile and wireless data communications, the architecture for which SSL was designed is not sustainable in the wireless environment. Mobile phone users would be disappointed by the delays required to process SSL transactions, and building in to handsets the processing power needed to support SSL capability would raise the unit cost of devices which rely on an affordable pricing model to accelerate market growth. So, alternative mobile-optimized methods are required.

With security requirements being so much greater for hand-held and wireless devices than for their desktop or fixed connection counterparts, the use of the GSM architecture for digital signatures has significant benefits. Each mobile telephone has its own smartcard or SIM card which identifies the user for service and billing, provides a storage medium for the private keys, and, as the key never leaves the card, it meets the prerequisites for a high degree of security. Current implementations of TDMA and CDMA have no accommodation for equivalent facilities. In discussion with a leading provider in the CDMA space, we learned that they are wrestling with how to provide similar functions, or indeed interoperability, with this useful consumer construct. The existing SIM manufacturers are working hard to provide continuity for SAT in the 3G standards–this may well be the opportunity to extend these benefits to the TDMA and CDMA world.

Taxonomy

WAP Security

In June of 1999, the WAP Forum formally approved WAP Version 1.1. which includes the Wireless Transport Layer Security (WTLS) specification. WTLS defines how Internet security is extended to the wireless Internet, and is intended to give network operators, application developers, and vendors a way of building the confidence of end-users and thus open whole new markets to e-commerce in the same way as the arrival of SSL did for the fixed-connection Internet.

The WAP security model and the Wireless Transport Layer Security (WTLS) mechanism are based on the Internet standard security protocol TLS 1.0, which in turn is based on SSL 3.0.

WTLS was specifically designed to conduct secure transactions without requiring desktop levels of processing power and memory in the handset. WTLS processes security algorithms faster by minimizing protocol overhead and enables more data compression than traditional SSL solutions. As a result, WTLS can perform security well within the constraints of a wireless network. These optimizations mean that smaller, portable consumer devices can now communicate securely over the Internet.

A secure WAP conversation occurs in two stages. First the transmission between the web server and the WAP gateway occurs over SSL. The onward transmission of this message over the air interface to and from the WAP browser device is over wireless networks using WTLS. Essentially the WAP gateway serves as a bridge between the WTLS and SSL security protocols.

There are considerations (some say limitations) in the introduction of a bridging protocol like WTLS. The current WAP security model requires a strong relationship between the network operator and the content provider. The WAP Forum has recognized that as the market for highly secure applications increases, a more flexible and extensible solution will be needed. When working across many different wireless networks, application developers must be assured that their content remains encrypted from the time it leaves their application server until it arrives at the WAP handset. As a result there is a process underway to develop this more advanced security solution, which must address the enterprise's need for higher security and the operator's need for proper integration with WAP gateways in the wireless network.

The WAP Forum is essentially a telephony standards committee, which is operating in an Internet world where standards are adopted by implementation rather than regulation and certification. There is

therefore some consternation that solutions are coming to market in advance of the WAP Forum having established a standard approach to providing end-to-end secure content. WAP gateways are designed for use in an operator's network; however, many of these new approaches promote installing a WAP gateway at a content provider or in an enterprise. As well as potentially diluting the network operator's hold on the customer–a development which many operators oppose–this creates a number of interoperability issues for content providers, subscribers, and wireless network operators. The WAP Forum members have recognized the problem and are seeking to address it.

Already, key Internet applications for handsets have been deployed, including e-banking, stock trading, e-commerce, and other exchanges of private and mission-critical data.

With WTLS optimized to ensure transactions are conducted in a secure and user-friendly way, and WAP-capable handsets reaching the market, subscribers are beginning to embrace wireless e-commerce in the same fashion that consumers adopted wired e-commerce over the last 18 months.

SIM Application Toolkit

The SIM Application Toolkit (SAT) is a GSM feature which was integrated into the GSM standards in Release 96, with further enhancements added as part of the Release 97 feature set.

The SIM is the Subscriber Identity Module, a computer chip on a plastic card permanently inserted into a GSM mobile phone containing a profile of the subscriber for billing, and so on. The SIM Application Toolkit defines a set of commands which enables an application on the SIM card to communicate with the mobile phone in a standardized format. Furthermore, cryptographic functions can be installed on the SIM card, enabling certain messages to be encrypted or signed.

The commercial driver behind the creation of SIM Application Toolkit was the requirement for network operators to be able to offer discrete value-added services, without the need for handset manufacturers to build network-specific models. This is possible because it is the network operator that owns the SIM. The networks requested that the SIM architecture be extended to allow for the placement of applications in the memory, and most importantly, that these new SIMs could work on any Mobile that supports the Toolkit feature.

Logically, the SIM Application Toolkit is completely separate from the GSM functionality on the SIM. There is a distinct set of commands between the Mobile and the SIM specifically for the toolkit. This allows the SIM toolkit on the handset to communicate in a client/server model independently of the GSM telephony communication. This logical split allows and encourages third-party applications, as well as operator-specific applications, to be resident on the SIM, with a co-located application part in the network or even outside of the network. Further, the toolkit can interact directly with the mobile itself, by adding to the mobile's menu structure. Other examples of handset behavior which can be controlled using SAT include sending a short message; setting up a voice call to a number held by the SIM; setting up a data call to a number and bearer capabilities held by the SIM; sending a Supplementary Services (SS) control or USSD (Unstructured Supplementary Services Data) string; playing a tone in the mobile's earpiece or ringer; initiating a dialog with the user. An optional "help" feature is also available so that additional help text can be displayed to the user if requested.

Local information, about cell identity, call status, coverage status, and so on, can all be used as the basis to provide value-added services to the subscriber, and can also be fed to the SIM application as and when the current local situation of the handset changes. The network can then provide an application to modify the handset behavior accordingly.

Communication between the toolkit application on the SIM and its "other half" on a server somewhere in the network is currently achieved by using the Short Message Service (SMS). This combination of SMS and the SIM Application Toolkit promotes the development of mobile phone applications which considerably ease the process of entering data (for example, a menu-driven bank system). In future, SAT will use other transport mechanisms, such as Unstructured Supplementary Services Data (USSD) strings or the General Packet Radio Service (GPRS).

Until now, each card needed its own development environment; however, the client/server implementation model of SAT also means that Java SIM cards can be used. With the JavaPhone API, developers can develop telephony features that are crucial to integrating value-added computing capabilities without sacrificing the instantaneous telephone service consumers expect. The Java Phone API will include power management, display controls, and data synchronization. The use of common Java applets has enabled the provision of compression algorithms, encryption/decryption, PKI interfaces, and the capability to validate digital signatures. which can be used to develop secure SAT applications for mobile phones.

Applications stored as Java applets will further encourage developers to produce applications, as they will enjoy the benefits of Java technology (namely operating system-independence) when programming SIM card applications. Applications only need be developed once and can then be loaded onto any card. Using SMS as a bearer, menus of existing applications can be updated or new applications downloaded onto the card. This approach reduces time-to-market and development costs.

Using the above, it is now possible for the SIM toolkit feature set to include data download to the SIM from the network, where an SMS is delivered directly to the SIM from the network, which could contain data or commands distinct to the toolkit application, or, indeed, allow a new application to be loaded into the SIM.

Considering the scale and variety of SIM-resident applications that will be available in the future (banking services, airline booking and inquiry services, and so on), some of which are commercially or security sensitive, the GSM SAT specification has been developed which standardizes the communication between the end-to-end entities in a secure way for SMS, so that it will be impossible for any messaging between the toolkit application and its counterpart in or behind the network to be intercepted, read, or modified.

Industry Groups Focusing on the AAA for Wireless and Mobile

In addition, to the efforts of the IETF, a number of other organizations are active in defining the needs of the security area.

PKI Forum

Public Key Encryption is seen as a critical component of the emerging Internet security and trust infrastructure. PKI (Public Key Infrastructure) enables users of an unsecured public network such as the Internet to securely and privately exchange sensitive data and conduct financial transactions through the use of a public and a private cryptographic key pair that is obtained and shared through a trusted authority. The Public Key Infrastructure provides for digital certificates that can identify individuals or organizations and directory services that can store and, when necessary, revoke them.

The Public Key Infrastructure assumes the use of public key cryptography, which is the most common method on the Internet for authenticating a message sender or encrypting and decrypting a message. Traditional cryptography has usually involved the creation and sharing of a secret key for the encryption and decryption of messages.

Use of asymmetric encryption methods requires reliable distribution of public keys. All users must be able to be sure that public keys really belong to those parties they are said to belong to. The solution is Public Key Infrastructure (PKI), certification authorities, and reliable third parties, which offer services. The objective of the infrastructure is to produce reliable security service for the net.

The PKI Forum, founded by Baltimore Technologies, Entrust Technologies, IBM, Microsoft, and RSA Security is an international, not-for-profit, multi-vendor alliance whose purpose is to accelerate the adoption and use of PKI (Public-Key Infrastructure) products and services. The PKI Forum advocates industry co-operation and market awareness to enable organizations to understand and exploit the value of PKI in their e-business applications.

The major objectives of the PKI Forum are:

- To accelerate the adoption and use of PKI as a critical enabler of e-business
- To enhance the value of PKI for customers and business partners
- To increase confidence in the deployment of PKI by customers and ISVs
- To accelerate revenue growth for PKI-based products and services

The PKI Forum operates as an autonomous, unincorporated entity within The Open Group, which provides legal and management services. The PKI Forum aims to provide a forum for vendors to demonstrate support for standards-based, interoperable PKI solutions for e-business. In a model becoming common in the high tech industry, the Forum serves to bring customers and vendors together in a vendor-neutral setting to increase customer knowledge about the value of PKI and demonstrate how PKI solves the security issues for e-business. It is hoped that that Forum will foster interoperability by interacting with appropriate standards and testing bodies and initiating studies and demonstration projects in order to show the value of interoperable PKI.

Through these efforts the Forum predicts it will accelerate the deployment of PKI and PKI-based solutions and communicate the compelling value of PKI as a trusted base for e-business applications.

To accomplish its objectives, the PKI Forum has established various working groups with active membership participation. Special interest groups may also be formed from time to time to resolve specific issues. Given the PKI Forum's initial objectives, at least two standing working groups will be formed. The Business Working Group will identify business-based interoperability requirements. The Technical Group will develop PKI interoperability profiles and champion product interoperability demonstrations to ensure that products are certified against those profiles.

The PKI Forum is not a standards body. Current formal standards organizations that address PKI (such as the IETF and ANSI) and other organizations which have a PKI industry focus (such as ANX, NACHA, BITS, and Identrus) play an important role in developing open standards and in fostering the emergence of sector-based PKI. However, baseline product interoperability is not their primary charter. With its emphasis on building an assured foundation of interoperable PKI products, the PKI Forum will directly support (and influence) the work of technical standards and interoperability profiles as specified by the IETF, The Open Group, ANSI, governmental Common Criteria programs, and industry-specific programs.

Radicchio

Radicchio is an organization founded by Sonera SmartTrust with GemPlus and EDS in September 1999 to promote PKI in secure wireless e-commerce and is well on its way to becoming the industry voice and authority in this space. Radicchio is registered in the United Kingdom, for the benefit of its members which include certification authorities, mobile operators, systems integrators, device manufacturers, and software companies. Radicchio aims to raise awareness of the opportunities presented by secure wireless e-commerce through the expansion of its membership.

The initiative promotes the use of an environment based on a Public Key Infrastructure (PKI), allowing secure electronic transactions to take place over wireless networks. As a consortium of the industry's leading wireless e-commerce companies, Radicchio will persuade international regulators and government bodies to accelerate the adoption of legislation which supports secure wireless e-commerce globally.

The stated goals of Radicchio are:

- To achieve worldwide industry awareness of the opportunities presented by secure wireless e-commerce and Public Key Infrastructure (PKI) technologies

- To become the industry voice and authority for PKI on personal wireless devices and networks
- To enable a dynamic global market for secure wireless e-commerce through high-level regulatory, process, and technical collaboration and consensus between members

Mobile Electronic Signature Consortium

The Mobile Electronic Signature Consortium was formed in January 2000 and is an association of companies and organizations from the mobile phone and Internet sectors. The basic pretext for forming the group is that the founder members assume that the current separation of mobile telecommunications and Internet as implemented in WAP will not last and that the isolated use of various electronic distribution channels will no longer be able to cope with consumer demands for integrated, mobile offerings and services. Only by using the legally effective digital signature it will be possible to perform business via electronic channels in secure and understandable form. The members are all working on the integration of mobile telecommunications and fixed connection Internet technologies to generate services that will require a mobile digital signature as a way to establish legal security for transactions performed.

From the end-user perspective it is intended to add a "signature" button to the mobile phone keyboard. This capability will be a benefit in the marketing of such devices The message this should create in the mind of the end-customer is that only mobile end-devices with a sign button provide access to secure electronic/mobile commerce.

Smartcards possess the storage capacity for the private key. This means that the implementation of a signature application on the card can be achieved by using the SIM Application Toolkit. Alternatively it will create the opportunity for a new card generation. The introduction of new add-on value services in co-operation with service and content providers is thought to provide a significant increase in value for network operators.

The main objective of the consortium is to develop a secure cross-application infrastructure for the deployment of mobile digital signatures. To achieve this objective, key players of the mobile telecommunications and Internet sectors will define a standard that facilitates the integration of the mobile phone and of other mobile devices into the current online world.

Current members of the consortium include BROKAT Infosystems AG, Bank of Tokyo–Mitsubishi, cryptovision gmbh, Deutsche Telekom/T-TeleSec, D-Trust GmbH, E-Plus Mobilfunk GmbH, Gemplus, HypoVereinsbank AG, Mannesmann Mobilfunk GmbH, ORGA Kartensysteme Gmbh, Schlumberger, Siemens AG, Sonera SmartTrust GmbH, TC TrustCenter GmbH, and VIAG Interkom GmbH & Co.

In principle, the Mobile Electronic Signature Consortium is planned as an open forum. Work on the development of respective business rules, among other things, for integrating new members is currently in progress.

The Mobile Electronic Signature Consortium will support application providers that require a legally effective statement of the customer to perform their business. Among these are providers of bespoke, critical services with a high level of security; for example, banks, insurance companies, lotteries, as well as trading agencies for upscale products. The standard to be developed will be freely available so that it can be integrated into already existing applications or be considered in the development of new and innovative applications.

Conclusion and Role of The Open Group

The Open Group should continue to monitor closely the activities of the IETF Mobile IP and Security working group and the Mobile Wireless Internet Forum (MWIF) to assess the extent to which the problems of AAA in the wireless space are being effectively addressed.

Existing Open Group enterprise integration activities addressing Security and eCommerce (LDAP-based), Directory Interoperability, and Enterprise Management are clearly synergistic with the needs of the wireless environment. The Open Group is able to bring together experts from the Mobile Management Forum and its existing programs to ensure that the wireless needs are addressed in a way that ensures smooth integration with existing enterprise systems.

Appendix 1: Acknowledgements

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3GPP

Appendix 2: Glossary

This is an extract of The Open Group's Mobile and Wireless glossary which can be found online at ww.openwirelessdata.org.

820.X	IEEE set of standards describing physical and electrical topologies (physical and data link layers), cabling, and access scheme for LANs.
ANSI	American National Standards Institute API (Applications Programming Interface)
ASCII	The American Standard Code for Information Interchange is a standard character set where each alphabetic letter and each number is represented by a binary code. A common for of data standard for data transmission.
ATM	Asynchronous Transfer Mode; used to refer to both a technology and the service that uses it. Information is transmitted in fixed-size packets called cells. Sometimes called cell relay, as in frame relay (see below).
Base Station	A transmitter and/or receiver that communicates with a radio-enabled mobile device.
bps	Bits per second; a measure for data transmission rate.
Browser	A graphical interface originally employed to access the world wide web, increasingly the interface of choice for some applications designers.
Bluetooth	A short distance mobile radio mechanism for portable devices.
CCIRN	Coordinating Committee for Intercontinental Research Networks.
CCITT	International Telegraph and Telephone Consultative Committee (now the ITU).
CDMA	Code Division Multiple Access is to America what GSM is to Europe and the world outside America and Japan. An air protocol considered ideal for handling multiple channels of data traffic.
CDPD	Cellular Digital Packet Data.
Circuit Switched	An uninterrupted connection between two callers designed for voice but can be dedicated to voice or data communication. Costs are typically based on total connect time.
Compact-HTML	Also called DHTML, a derivative of HTML for mobile devices; also see HDML.
Compression	Using algorithms to decrease the size of a data object to be transmitted, thereby increasing the efficiency. A similar algorithm will expand the file back to its original size at the point the object is used.
CSMA	Carrier sense multiple access; a structure where stations listen to network activity and if it is not in use a station is permitted to transmit. CSMA is often combined with Collision Detection (CD).
CTIA	Cellular Telecommunications Industry Association.
DAMPS	The prevailing standard in the U.S., Digital Advanced Mobile Phone System. Based on the IS-54 (800MHz) and IS-136 (1900 MHz) standards–often referred to as TDMA (see below).
DECT	Radio standard for cordless telephones providing wired telephone quality. Planned to handle data. Stands for Digital Enhanced Cordless Telecommunications.
DHCP	Dynamic Host Configuration Protocol provides dynamic address allocation in TCP/IP configurations in addition to static definitions DHTML–also called Compact HTML, a derivative of HTML for mobile devices.
DSL	Digital Subscriber line; a digital connection between a customer and the telephone company.
DSP	Digital Signal Processing refers to various techniques for improving the reliability and accuracy of digital communications.
ECMA	European Computer Manufacturers Association.
ECTF	Enterprise Computer Telephony Forum.
Encryption	Privacy encoding of voice and/or data.
ETSI	European Technical Standards Institute established by the European Commission.
Extranet	The part of an organization's internal web sites that is available to external customers and suppliers, and so on.
GPRS	General Packet Radio Service, expected from 2000 as an extension to the GSM standard for packet data services.
GPS	Global Positioning System allows an exact position anywhere in the world to be calculated using triangulation form at least three satellites to arrive at a grid reference.
GSM	Global System for Mobile Communications–a world standard for digital cellular networks widely accepted outside the U.S. and Japan. It operates at 900MHz supporting data rates up to 9600bps currently (planned to extend to 14,400bps and beyond).
GSM1800	A variant of GSM used by some governments to provide more air capacity. Identical to GSM except that it uses 1800MHz. Some providers use GSM1800/1900 dual band (see GSM1900 below).
GSM1900	A U.S. derivative of GSM using 1900MHz.
GSM Association	A non-profit Dublin-based organization founded to champion the GSM standard, including GSM 900MHz, GSM1800, and GSM1900. Has 200 to 300 members form over 100 countries striving to evolve the GSM standard.
HDLC	High-Level Data Link Control; a bit-level link layer protocol developed by the ISO.
HDML	Handheld Device Markup Language; an HTML derivative designed for mobile devices with restricted display ability. The Wireless Applications Protocol (WAP) forum wants to rename HDML to WML–Wireless Markup Language.
HSCSD	High Speed Circuit Switched Data proposes to increase GSM data throughput by combining (two or more of eight) 9600bps channels. Likely to be superseded by GPRS (see above).
HTML	HyperText Markup Language, based on the Standard Generalized Markup Language (SGML) used to create pages on a World Wide Web server (see Compact HTML).

HDTP	Handheld Device Transfer Protocol based on HTTP (see below) designed to handle dropped connections.
HTTP	HyperText Transfer Protocol designed to transfer pages between web servers and target devices.
IEEE	Institute of Electrical and Electronics Engineers.
IESG	Internet Engineering Steering Group.
IETF	Internet Engineering Task Force.
IETF Mobile	Internet Engineering Task Force Mobile IP working group.
IMT-2000	International Mobile Telecommunications 2000 is the standard for third-generation mobile communications systems. Referred to as UMTS it is being implemented in Europe from about 2002. Target for mobile data rates of up to 144,000bps and up to 2Mbps for stationary systems. The industry appears to prefer W-CDMA (Wideband CDMA) as the air access. IMT-2000 could provide the basis to integrate satellite, digital cellular, and cordless in a mobile device.
InterNet	A collection of networks and gateways that use TCP/IP protocols (includes ARPAnet, MILnet, NSFnet, and so on).
Intranet	The deployment of Internet technologies within a company or organization. Includes web servers, mail servers limited to the company.
IP	Internet Protocol (see TCP/IP below).
IRTF	Internet Research Task Force, tasked to consider the long-term research problems in the Internet.
ISDN	Integrated Services Digital Network; a limited set of standard interfaces to a digital communications network as defined by CCITT.
ISO	International Organization for Standardization.
ISP	Internet Service Provider.
ITU	International Telecommunication Union; international telecommunications standards body that also brings about radio spectrum allocation treaties.
Kbps	Thousand of bits per second, a measure for data transmission rate.
LAN	Local Area Network; a network limited typically to a few miles used for high speed (2 to 100Mbs) computer connections.
LDAP	Lightweight Directory Access Protocol uses a subset of the X.500 directory standard for clients to identify network resources, especially for the Internet.
MDA	Mobile Data Association
MexE	Mobile Station Application Execution Environment.
MP	Also referred to as MPPP and MLPPP, a protocol providing data compression, error control, and multiple transmission protocol handling. Supersedes PPP and SLIP (Serial Line Internet Protocol).
NAT	Used by some firewalls and routers to provide a secure proxy interface to the Internet. Stands for Network Address Translation and maps internal IP addresses to legitimate Internet addresses (many-to-one or one-to-one).
OSI	Open Systems Interconnection reference model divides network functions into seven layers, each layer dependent and building on the services of the layer beneath it.
Packet Network	A model where the user is charged per packet (objects are broken up into packets that are routed to their target destination). The end-user connection is constantly open. Availability on digital cellular networks is targeted for 1999.
PAD	Packet Assembler and Disassembler converts data into packets and *vice versa*.
PAMD	Public Access Mobile Data; generic term for packet data networks.
PAMR	Public Access Mobile Radio.
PANS	Pretty Amazing New Services; refers to new third generation systems; contrast with POTS.
PCN	Personal Communications Network; digital telephony standard based on a subset of GSM1800.
PCS	Personal Communications Service; a term for systems that use GSM1800 and GSM1900, especially in the U.S.
PDA	Personal Digital Assistant.
PMR	Private Mobile Radio a private analog radio network used by emergency services where digital does not (yet) prevail (such as the U.S.). Also termed SMR or Special Mobile Radio.
POTS	Plain Old Telephone System refers to "old iron" telephone networks; contrast with PANS!.
Protocol	In the networking context, a set of rules for controlling data flow.
PSTN	Public Switched Telephone Network; the public telephone system.
PTT	Postal, Telegraph, and Telephone.
Roaming	An agreement for a mobile device to use a network other than the one it initially contracted with. Complicated by revenue sharing and billing issues. Global roaming facilitated by GSM.
SCN	Switched Circuit Networks, such as PSTN/ISDN and GSM.
Satellite	Analog and digital services available to support mobile.
SERG	Services Expert Rapporteur Group of the GSM association is tasked to drive the rapid, yet common, development of GSM functionality and services within ETSI, ensuring the short and medium-term viability of the GSM platform.
SGML	Standard Generalized Markup Language (ISO 8879).
SIG	Special Interest Group.
SIM	Subscriber Identity Module; a computer chip on a plastic card permanently inserted into a device containing a profile of the subscriber for billing, and so on. Could evolve to a credit card format allowing insertion into any device.
SMG	ETSI Special Mobile Group.
SMS	Short Message Service; a GSM facility for sending up to 160-character messages between compatible devices. Often used for alerts on cellular phones (voice message waiting, and so on).
Spoofing	Extremely fast dial-up routines used to simulate a constantly open connection on a circuit switched network. The speed of establishing the connection makes it appear that the connection was never interrupted.
TCP/IP	Transmission Control Protocol/Internet Protocol is the standard used by the Internet to transfer information between computers. Data is divided into separate packets that can be reassembled.

TDMA	Time Division Multiple Access; an air protocol developed for handling multiple channels of voice traffic on one cellular frequency. GSM uses TDMA. Also in the U.S. the IS-54 (800 MHz) and IS-136 (800 and 1900 MHz) digital cellular standards.
TETRA	Terrestrial Trunked Radio Access; a digital standard embracing private and public access mobile radio for packet voice and data.
TIA	Telecommunications Industry Association.
TIPHON	ETSI Project TIPHON; Telecommunications and Internet Protocol Harmonization Over Networks.
TLA	Three Letter Acronym.
TTFN	Ta-Ta For Now.
TTML	A subset of HTML; Nokia's protocol for presenting information accessed from the Internet on GSM phones.
URL	Universal Resource Locator (*aka* the human-friendly www web address used to address an Internet site).
UMTS	Universal Mobile Telephony Standard; European version of IMT-2000.
UMTS Forum	Non-profit organization to develop UMTS made up of IT and telecommunications companies. Has over 100 members.
UWCC	Universal Wireless Communications Consortium; carriers and vendors that support TDMA IS-54/136 radio access and IS-41 core standard.
W3C	World Wide Web Consortium.
WAN	Wide Area Network.
WAP	Wireless Applications Protocol to bring Internet content to mobile devices. Championed by Motorola, Nokia, Unwired Planet (as was, now phone.com), and so on. Uses WML.
WAP Forum	Wireless Applications Protocol Forum.
WDF	Wireless Data Forum.
W-CDMA	Wideband CDMA, radio access standard proposed for UMTS services.
WML	Wireless Markup Language.
WRT	With Respect To.
XML	eXtensible Markup Language describes a class of data objects called XML documents which are stored on computers, and partially describes the behavior of programs which process these objects. XML is an application profile or restricted form of SGML.
X.25	Packet-switched data network communications standard.
X.28	Asynchronous character communications standard used for access to X.25 networks.