

Wireless Networking

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Abstract- Wireless technology has helped to simplify networking by enabling multiple computer users to simultaneously share resources in a home or business without additional or intrusive wiring. These resources might include a broadband Internet connection, network printers, data files, and even streaming audio and video. This kind of resource sharing has become more prevalent as computer users have changed their habits from using single, stand-alone computers to working on networks with multiple computers, each with potentially different operating systems and varying peripheral hardware. Wireless networking enables the same capabilities and comparable speeds of a wired 10BASE-T network without the difficulties associated with laying wire, drilling into walls, or stringing Ethernet cables throughout an office building or home. Laptop users have the freedom to roam anywhere in the office building or home without having to hunt down a connector Cable or available jack. Every room in a wireless Home or office can be "connected" to the network, so adding more users and growing a network can be as simple as installing a new wireless network adapter.

I. INTRODUCTION

Wireless Internet is one of the hottest topics today in the technology field. However, there is uncertainty about which new wireless applications might be relevant to customers, employees, and profitable to companies. It's important how businesses could create and sustain value by analyzing how mobile technologies can be used to create benefits that could not be realized in a "fixed" world. Also it is important for companies to gain a better understanding of how the personalized, localized, synchronized and anywhere/anytime characteristics of wireless can benefit their business. One of the mobile commerce pioneers is NTT DoCoMo, with its leading edge wireless mobile communication service I-mode. I-Mode (the I stands for information) is a wireless technology developed by the Japanese company NTT DoCoMo that enables users to access Internet services via their cellular phones. I-mode is based on packet data transmission technology.



Fig 1: Wireless Network

This means that I-Mode is always active, and therefore users are charged only for how much information they retrieve, not how long they are online. I-Mode can be used to exchange e-mail with computers, personal digital assistants (PDA's) and other I-Mode cellular phones.

I. Five Questions to Start With

A. What Is a Wireless Network?

What is a wireless network? How is it different from a wired network? And what are the business benefits of a wireless network? The following overview answers basic questions such as What is a wireless network?, so you can decide if one is right for your business.

B. What Is a Wireless Network?

A wireless local-area network (LAN) uses radio waves to connect devices such as laptops to the Internet and to your business network and its applications. When you connect a laptop to a WiFi hotspot at a cafe, hotel, airport lounge, or other public place, you're connecting to that business's wireless network.

C. What Is a Wireless Network vs. a Wired Network?

A wired network connects devices to the Internet or other network using cables. The most common wired networks use cables connected to Ethernet ports on the network router on one end and to a computer or other device on the cable's opposite end.

D. What Is a Wireless Network? Catching Up with Wired Networks

In the past, some believed wired networks were faster and more secure than wireless networks. But continual enhancements to wireless networking standards and technologies have eroded those speed and security differences.

E. What Is a Wireless Network?: The Benefits

Small businesses can experience many benefits from a wireless network, including:

- 1) Convenience. Access your network resources from any location within your wireless network's coverage area or from any WiFi hotspot.
- 2) Mobility. You're no longer tied to your desk, as you were with a wired connection. You and your employees can go online in conference room meetings, for example.
- 3) Productivity. Wireless access to the Internet and to your company's key applications and resources helps your staff get the job done and encourages collaboration.
- 4) Easy setup. You don't have to string cables, so installation can be quick and cost-effective.
- 5) Expandable. You can easily expand wireless networks with existing equipment, while a wired network might require additional wiring.
- 6) Security. Advances in wireless networks provide robust security protections.

II. REASONS TO CHOOSE WIRELESS NETWORKING OVER TRADITIONAL WIRED NETWORKS INCLUDE

- 1) Running additional wires or drilling new
- 2) holes in a home or office could be prohibited
- 3) (because of rental regulations), impractical
- 4) (infrastructure limitations), or too expensive
- 5) Flexibility of location and data ports is required
- 6) Roaming capability is desired; e.g., maintaining
- 7) connectivity from almost anywhere inside a
- 8) home or business
- 9) Network access is desired outdoors; e.g.,
- 10) outside a home or office building

III. WHAT IS I-MODE

I-mode is the platform for mobile phone communications that has revolutionized the way more than one-fourth of the people in Japan live and work. The first of its kind, this remarkably convenient new form of mobile service has attracted over 38 million subscribers since its introduction in February 1999. With I-mode, cellular phone users get easy access to more than 66,000 Internet sites, as well as specialized services such as e-mail, online shopping and banking, ticket reservations, and restaurant advice. Users can access sites from anywhere in Japan, and at unusually low rates, because their charges are based on the volume of data transmitted, not the amount of time spent connected. NTT DoCoMo's I-mode network structure not only provides access to I-mode and I-mode-compatible content through the Internet, but also provides access through a dedicated leased-line circuit for added security. I-Mode is foremost a brand, not a technology. This brand is owned by NTT DoCoMo, Japan's largest ISP. In some ways, I-Mode is equivalent to AOL: both are a brand representing a service or family of services. Until now, DoCoMo's advertising focused more on entertainment than on business applications. As is the case for the wired Web based mostly on PCs, the I-Mode killer app is email, comprising nearly half of the total traffic. If we look at the technology, the I-Mode service is based on packet switched overlay over circuit-switched digital communications. In contrast to most European or North American WAP services, it is based on TCP/IP, is always on, and hence does not require a dial-in connection. The content is encoded in an HTML variant named *cHTML* (*Compact HTML*). From the marketing point of view, I-Mode is incredibly popular. It went from zero to eleven million subscribers in about a year and a half. (I ought to add, however, that there are about 60 million mobile phone users in Japan.) Mobile phones are less expensive than land phones, especially considering installation costs. Surprisingly, there are also more WAP users in Japan than anywhere else. In fact, the Japanese wireless Internet market is the biggest in the world. According to Euro technology, the approximate market share for wireless Internet is represented in this graph.

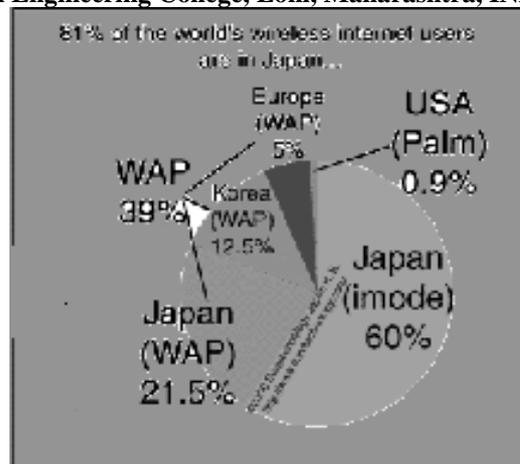


Fig 2: Use of I-Mode

IV. REQUIREMENTS

To realize the WWW browsing function for such small devices, a suitable subset of HTML is necessary. The requirements are derived from the above hardware restrictions. Also these devices should be easy to use from the standpoint as consumer products. The browser software for a subset of HTML should run within the small memory: e.g., 150-200Kbytes for the working data and also 150-200Kbytes for the program code. The minimum requirement for the CPU power

V. I-MODE NETWORKING ENVIRONMENT

I-Mode is the proprietary protocol of NTT DoCoMo of Japan. I-Mode provides Internet service using Personal Digital Cellular-Packet (PDC-P) and a subset of HTML 3.0 for content description. I-Mode allows application/content providers to distribute software (Java applets) to cellular phones and also allows users to download applets (e.g., games). I-Mode uses packet switched technology for the wireless part of the communication and is carried over TCP/IP for the wired part of the communication. Packet switching systems send and receive information by dividing messages into small blocks called packets and adding headers containing address and control information to each packet. This allows multiple communications to be carried on a common channel. This allows for efficient channel usage with low cost. "DoPa," which is DoCoMo's dedicated data communications service, offers connections to LAN and Internet service providers by applying this principle of packet switching to the wireless section as well. The mobile packet communications system has a network configuration in which the packet communications function is added and integrated into DoCoMo's Personal Digital Cellular (PDC) which is the digital system for portable and automobile telephones. DoCoMo has developed a data transmission protocol specific to I-Mode. This protocol is used with DoCoMo's PDC-P system. Connections between the I-Mode server & Internet use generic TCP/IP technology.

The PDC-P network includes a mobile message packet gateway (MPGW) to handle conversions between these two protocol formats. The I-Mode server is a regular Web server. It can reside at NTT DoCoMo or at the Enterprise. DoCoMo has been acting as a portal and so “normally” maintains the I-mode server. For future implementations with advanced security requirements, it is possible to host the I-Mode server at the Enterprise.

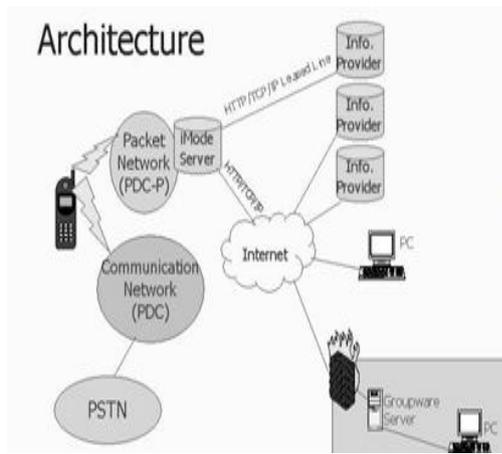


Fig 3 : Architecture of I-Mode

VI. I-MODE SPECIFICATION

I-Mode is a proprietary service currently only offered in Japan and can not be made readily available on any other service carrier's network. The I-mode specification is a proprietary protocol of NTT DoCoMo of Japan. As such, the details of the protocol and specification are not publicly available. The protocol stacks used by I-Mode have been reported in public forums. I-Mode Security is provided at the transport layer using SSL/TLS and is based on the security provided by these Internet protocols. The TL and LAPD-M protocols are standards of the Association of Radio Industries and Business (ARIB). I-Mode uses compact HTML, or “cHTML” for representing on-line (on-air) content. The structure of cHTML means that a user can also view “traditional” HTML pages although cHTML pages look better. This is in contrast to WAP, where HTML pages must be translated to WML.

VII. I-MODE GATEWAY

A gateway translates wireless requests from a mobile phone to the server. It also sends information from a gateway back to the mobile phone. NTT DoCoMo provides a gateway to their users; however, this is only available to those in Japan. There are other gateways on the market that allow users outside of Japan to build new mobile Internet services based on cHTML. One of the new gateways to hit the market is the m-World Gate. This is the world's first commercially available cHTML gateway.

1) Entertainment–

Character Download, Horoscope/Fortune telling, karaoke info/hit songs, FM /Club event info, download ring tones.

2) Information –

News Updates, Weather Forecasts, Sports News, Stock Quotes, Business / Technology News, Town Information, Horse Racing Information, etc

3) Database Access -

Telephone Directory Search, Restaurant Guide, Dictionary Service, Cooking Recipes, etc

4) Transaction –

Money Transfer / Balance Check, Security Trading, Airline reservation / Seat Availability, Credit card Information Sales, etc.

IX. WAP OR I MODE: WHICH IS BETTER

The problem, WAP detractors see it, is in Internet mark-up language. Websites have historically been grounded in the meta-data system language known as HTML, which isn't compatible with a WAP phone. WAP phones are best served by wireless mark-up language (WML). Unless a website is written in WML, a WAP phone can't access it. And there are only 24,000 WAP-accessible sites in the world, according to wireless resource *pinpoint.com*. I-mode can read practically any Web page (with varying degrees of legibility) and charges users for the amount of information downloaded rather than air time. I-mode is served by cHTML, which technically can allow users to access desktop HTML sites, although it looks better if it's been written in cHTML. "Since WAP defines a new mark-up language, content providers have to learn how to make content with it". So this is a big hurdle faced by the WAP service providers. Moreover I-mode offers more affordable access rates, more robust content and higher connection speed. Before accessing a site, WAP users must agree to pay extra charges and even type in URLs to browse through sites other than the service provider's portal. I-mode phones have a one-button browsing method, eliminating the need to type in Web addresses. The transfer speed for I-mode is fast and WAP is slow at this moment. The I-mode offers a lot of content for a fairly inexpensive price. You can send messages relatively inexpensively: for 100 characters, about a cent and a half. Because I-mode is a proprietary, closed standard, thus American & European companies, and some Asian companies want an open standard where they can have a choice of vendors. WAP is designed to work on any network platform. The technology of I-mode cannot be deployed on other networks.

X. FACTORS OF SUCCESS

There are four major things that make the difference between I-Mode and WAP:

- 1) Easy-to-use terminals
- 2) Different end-user focus (businessmen versus adolescents)
- 3) Internet hype
- 4) Packet switched data
- 5) These factors are not directly linked to the technologies behind I-Mode and WAP,
- 6) but rather to external circumstances.

2) i-motion : DYNAMIC VIDEO CONTENT

Motion is a video-clip distribution service available through FOMA, NTT DoCoMo's third generation (3G) mobile network. i-motion adds to the existing range of enhanced I-mode offerings, allowing users to enjoy dynamic video content that expresses more than words ever could. Users can watch sports highlights, press conferences, movie previews, promotional videos, music videos and more. FOMA's high-speed data transmission functions enable i-motion to deliver three kinds of content: video with sound, still frames with sound, or sound files alone. The video with sound pattern replays videos clips such as sports highlights, promotional videos and news with a maximum length of approximately 40 seconds. The still frames with sound pattern replays still images such as famous movie scenes, and news and graphics with sound files that have a maximum length of about 30 seconds. The sound-only pattern replays files such as music for trial listening, and are a maximum length of about 100 seconds. Subscribers with camera-equipped FOMA terminals can also record their own video files and send them as e-mail by using the i-motion mail service. Access to audio and video content through high-speed packet transmissions with reception rates of up to 384Kbps.

XI. PACKET SWITCHED DATA VERSUS CIRCUIT SWITCHED

The most important success factor for I-Mode is probably that services are delivered through packet switched networks instead of circuit switched as is the case for WAP services today. While circuit switched technology implies that the user will have to get connected first (similar to using a modem), the user is always connected with packet switched technology. This improves the user experience, as usage is not as slow if you are always connected. Today with WAP the user pays for the time he/she is connected, which is inevitable when using circuit switched technology, since the line is occupied whether you use it or not. Packet switched technology makes it possible to charge only for the usage of a service, based on the size transmitted or the value of the service to the end-user. In I-Mode a combination of those two is used. This also makes it possible to provide mobile services cheaper than today. However one has to realize that this is not the case in Japan today. I-Mode services are equally expensive to WAP services in Europe. The use of circuit switched networks today is however not due to WAP. WAP works fine in packet switched networks as well. The reason for the circuit switched technology is that WAP today is used in GSM networks. With the introduction of GPRS and 3G networks this will change.

3) i-appli : I-mode WITH JAVA

With I-mode's revolutionary new service, i-appli, based on the Java programming language, users of compact, Java-compatible I-mode terminals download advanced software and content from more than 659 Web sites -- and then use the downloaded applications / content whenever they want, without ever having to reconnect to the Internet. i-appli uses the formidable Java platform developed by Sun for consumer electronics and built-in devices, as well as I-mode's large extended library, which was developed jointly by the two companies. Since the data processing power of mobile phones is far less than that of PCs, I-mode uses a version of Java called "KVM" that runs on systems with relatively low processing power.

XII. APPLICATIONS

1) IShot : DIGITAL CAMERA CAPABILITIES

NTT DoCoMo's i-shot combines digital camera capabilities with mobile phone technology in one versatile and easy-to-use package. Subscribers simply switch their i-shot-enabled mobile phones to camera mode and the built-in camera activates. The potential shot can then be viewed on the phone's main display and an image can be recorded with the press of a button. Special effects can also be applied to images and a range of frames are available to choose from. Once the subscriber is satisfied with the results, all they have to do is attach the picture to an e-mail and send it. I shot also tailors the method of reception according the destination device. For I mode mobile phones, pictures are uploaded to the i-shot center and the appropriate URL is e-mailed. For PCs and the mobile phones of other companies, the actual image can be received as an attachment.

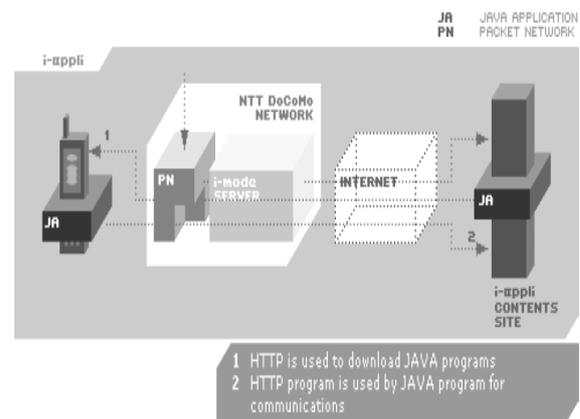


Fig 4 : Architecture of I-Mode

A key feature of the KVM environment is that its security functions are superior to those of standard Java. So, i-appli users don't have to worry about unauthorized viewing of their digital address books and other personal files, or the unintentional placing of calls billable to them. Although KVM i-appli won't directly run standard Java programs, users can easily convert many Java applications for I-mode use with minimal changes in functionality. Significantly, the overall architecture of the I-mode network remains the same with the advent of i-appli. With I-mode terminals, i-appli users download Java applications from conventional HTTP Internet sites just as easily as they do HTML documents, and Java programs on I-mode terminals also use the convenient HTTP format for data communications. Best of all, i-appli content is graphically rich and simple to use, containing the kind of expressive images, text, and sounds that are possible only with Java. Java's open specifications are setting the stage for even more business applications in the future.

XIII. I-MODE SECURITY

Mobile commerce (m-commerce) is conducted on I-mode including mobile banking and security trading. Therefore security becomes a serious issue. The security issues on I-mode are divided into different sectors-

- (1) Security of the radio link between I-mode handset & the cellular base station (this link uses proprietary protocols & encoding controlled by NTT)
- (2) Security of the transparent public internet connection between I-mode sites and the handset in the cHTML layer.
- (3) Security of private networks on I-mode.
- (4) Security of private network links between the I-mode center and special service providers such as banks.
- (5) Password security.

XIV. LIMITATIONS

There are three main limitations to I-mode's current structure:

- 1) Since cHTML is a simplified version of HTML, and that cellular phone has
- 2) Limited display area, information displayed over the I-mode center is limited.
- 3) 2. Emails are limited to 500 Japanese characters per email, approximately 300-
- 4) 400 English words. Extra words or attachments would be deleted and cannot be retrieved.
- 5) As I-mode continues to add new technology to its service, handsets need to be
- 6) Replaced accordingly to these new features.
- 7) Most of the web content supported by I-mode is in Japanese language because of its origin.
- 8) At present an imode page needs to be smaller than 5 Kbytes, but it is recommended that pages are on the order of 3 Kbytes for faster loading.

The future of I-mode is now. As of March 2002 I-mode service will be available in Germany and is set to be unveiled in Belgium and Holland in the following months. . Combined with the seemingly endless release of new services and DoCoMo's low pricing strategy, the future of mobile technology is I-mode. By constantly adding new services and features both NTT DoCoMo and E-Plus (NTT's European partner) have been able to attract new subscribers as well as retain old ones. Some of the more interesting of these services include: a sports ticker service where subscribers will be notified of major events that occur during selected sporting events, dating services, virtual pets, and the system independent coding language JAVA. Also thanks to Jamba, I-mode will soon be able to deliver 2 channels of up to 16 tones, allowing sound quality comparable to the original pieces of music. From online maps to TV guides to cyber shopping, the near future for I-mode services is full of innovation. These DoCoMo sponsored services are complemented by a growing list of third party developers who also see a very bright future for I-mode. JAL Japan's leading airline is currently setting up an I-mode flight booking service. Adding to a large list of third party developers such as AOL, HP, Google who is to power I-mode's search engine, and database giant Oracle corp. who has signed a deal with DoCoMo to create software that allows Oracle database access through I-mode hand-sets. I-mode's value is further extended by the soon to be released c-mode, which will allow I-mode users to dial into vending machines and have the vending machine fee added to their I-mode bill. It means that not only does NTT see the prosperous future of I-mode but so do the market and countless other industry companies. Several new features are on the horizon as part of the second phase of 3G. 3G along with the introduction of the W-CDMA standard will allow I-mode terminals to send longer e-mails, view video and audio enhanced pages via imotion. Another key improvement to I-mode is the increase in bandwidth from 64kb/s downstream to 384kb/s downstream and eventually by the end of the FOMA 3G product run 2Mbit/s. This increase in bandwidth will be the foundation for a new flood of I-mode services such as video conferencing and more multimedia content. By 2006 when 4G is unveiled four years ahead of schedule, downstream bandwidth will have increased to a screaming 20Mb/s. This as well as a predicted increase in micro storage capacity will allow I-mode phone to be able to download live media content and streaming movies in a matter of seconds. Some other innovations further down the pipe line are integration of QoS, to wearable I-mode and medical sensors. This is all due to the many partnerships DoCoMo has formed as well as NTT's strong commitment to R&D. What does this mean for mobile phone users? It means multi-media packed content at a fraction of the cost of a WAP phone.

Because of the numerous benefits, I-mode has become the most talked about mobile innovation in years and will continue to do so through NTT's business strategy for the future.

XVI. CONCLUSION

I-Mode is a combination of available technologies. Although CDMA and CHTML are not distinguished technologies, I-Mode proved that these technologies were enough to satisfy 6.5 million customers needs. They want a quick\ continuous connection to Internet from anywhere in anytime at reasonable costs, though transmission speed is lower than their PC Internet connections. Moreover, I-Mode is changing information system of existing business. Customers no longer want to call somebody in an office. They need a direct contact to their sales representative and customized information that they can read with their smart phones. I-Mode demands information managers to change their system from CEO's secretary to assistants of sales representatives.

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