

# **i-mode**

**CMPUT 499  
Presentation**

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## What is i-mode?

In a nutshell, i-mode allows for a cellular phone to access to the Internet. i-mode, which is relatively new to North Americans, refers to both a technology and a wireless service owned by NTT DoCoMo (the subsidiary of the major Japanese telecommunications company, Nippon Telegraph and Telephone Corporation). With i-mode, you can, not only talk on your cell phone, but you may browse i-mode compatible web sites as well. As of March 24<sup>th</sup>, 2002, I-mode has approximately 32 million subscribers in Japan alone. That is roughly equal to the population of Canada! Clearly, I-mode is a huge success in Japan. Ultimately what separates I-mode from other wireless internet technologies (such as Bluetooth, WAP, and J-sky) are three key components: the handset device, the transmission system, and the markup language.

## The Handset Device

Can any cellular phone access the Internet using i-mode? No. If a cellular phone would like to access the Internet using i-mode, then the cellular phone must be an  i-mode enabled device.  An i-mode enabled device contains a web browser, which decodes and displays web pages that are encoded in iHTML (the official markup language for I-mode). In addition to having an i-mode enabled device, one must also have a contract with NTT DoCoMo.

There are a wide variety of styles and models available from various vendors (Sony, NEC, Panasonic, Nokia, Ericsson). Some differences from model to model could be:

- Display (16, 256, 65536 colors)
- Available payment plans
- Visually appealing looks
- Weight
- Capabilities (Java enabled, water resistance).

Essentially, an I-mode enabled device is simply an equivalent to a low-end computer. It has small amounts of memory and disk space. It also has its own mini keyboard and a hundred megahertz CPU. There is also a small color display (approximately 1.5 square inches).

## The Transmission System

Currently I-mode's multiple protocol access system is Code Division Multiple Access (CDMA). Basically CDMA is a method, which efficiently allocates a wireless channel. The key to CDMA is that although many collisions may occur, the garbled signal may be decoded and the desired signal may be extracted while rejecting everything else.

Using CDMA, I-mode transmits data at a rate of 9.6 kbps. The transmission speed (data rate) is quite slow in comparison to the speeds desktop users are accustomed to as most Internet users today, are at least on a 28.8kbps modem. However, it should be noted that the average size of an I-mode web page is 3 kilobytes (the maximum is 5 kilobytes). Therefore, one might ask  How much speed is necessary when the average size of a web page is quite small?  9.6 kbps is considered to be satisfactory. It's not great but it is sufficient.

In the near future, the available bandwidth will be increased to support maximum transmission speeds of 384 kbps as CDMA will be replaced with the more potent and advanced, Wideband-Code Division

Multiple Access (W-CDMA). With this increase in potential transmission speed, i-mode is capable of handling multimedia content such as mpegs and mp3s. Eventually an i-mode enabled device will have the potential to conduct video conferencing, and act as a mobile audio player and a mobile television. As the saying goes, for I-mode, the sky is the limit.

i-mode uses packet switching technology which implies that users will pay by the number of packets transmitted. Usually, paying by the number of packets transmitted will result in lower costs than having to pay by connection time (like most WAP-based devices in Japan). The key to a packet-switched network is that a user is always online (i.e. there is no dial-up).

## The Markup Language

The official markup language for i-mode is iHTML. iHTML is a subset of HTML 2.0 with a few additional i-mode only attributes to various tags. iHTML web pages may be viewed with everyday web browsers such as Netscape or Microsoft Internet Explorer since iHTML is a subset of HTML. The main advantage of iHTML from a site-developer's perspective is that it is easier to learn than other wireless markup languages (such as WML). As a result there are more information sources for i-mode than other wireless internet devices such as WAP-based devices. There have been rumblings that both iHTML of i-mode and WML of WAP, will become obsolete and replaced with a more common standard such as XHTML.

## WAP vs. i-mode

The old question was: which is better? The new way of looking at the debate is to see how the technologies are converging. WAP (Wireless Application Protocol) is a protocol, making it possible for users applications to have universality in terms of connection and data exchange. i-mode is a service, and a major proprietary technology from NTT DoCoMo. The WAP Forum is made up of several large wireless players. i-mode captures market share by providing an all-in-one package, which also includes other content providers besides NTT DoCoMo.

In the early stages of the game, WAP was implemented on a circuit-switched network, and most companies charged by the time online. i-mode ran on a packet switched network, which allowed the user to be online, all of the time and allowed a client to be billed by content downloaded. It has been NTT DoCoMo's practice to invest in companies that it wants to partner with. AT&T is one example. WAP is a forum where companies agree to standards. It is perhaps easier for companies to offer their products online with i-mode than it is with WAP. You need a web-server and access to the iHTML language. It has been the case that even individuals can bill for content online. WAP has the backing of multi-billion dollar companies also, but does not have the particular backing of one company.

i-mode and WAP are different at the handset level. In Europe both WAP and i-mode run on GPRS networks. However, unlike WAP enabled cell phones, which must use a gateway to connect to the Internet, i-mode has an IP stack built into the handset. Requiring a gateway to decode and re-encode messages traveling between two communicators can be a possible security problem for WAP.

## Why i-mode is more popular?

In Japan, the focus for the i-mode user is entertainment, as well as business. It is inexpensive to use the service if you just stick to one particular feature, such as email. However, NTT DoCoMo makes money by providing other services. It has the power to extend the network and add new features.

WAP has not been the choice of a major player in the Japanese hand-held-Internet devices market and has been hampered by a small number of web sites devoted to WAP, using WML as the markup language. iHTML is closer to HTML so developers who already know HTML basically know iHTML.

The future looks positive for the convergence of WAP and i-mode. Both the WAP Forum and NTT DoCoMo have agreed within their respective organizations that XHTML will become their wireless markup language for subscribers. Wire-less Profiled TCP has been submitted to the IETF as DoCoMo's Transport Layer Protocol which is also a subset of WAP NG, the next generation WAP protocol. i-mode, and WAP acting like a service and since XML will become the markup language of choice, the expectation is that i-mode and WAP will converge.

## **i-mode security**

In order to secure DoCoMo's network or to possibly hide proprietary information about its protocols, NTT DoCoMo has kept the methods used to transport data from the handset to a gateway secret. However, that has not stopped people from trying to play pranks on i-mode's users. One such prank is to redirect the user of a hand-held device to an emergency number. This is accomplished by getting the user to press a hot key in response to a question or message. In response, i-mode has issued alerts.

One interesting note on the fight against crime, Japanese police are urging customers with a 3G phone, to use the built in digital camera in handsets to capture crime as it takes place, and email the footage to police for inspection.

In order to secure wireless Internet transactions, as of version 3.0, SSL (Secure Socket Layer) has been used and major companies such as RSA and Mitsubishi have provided encryption algorithms and digital certificates.

## **Java and i-mode development**

Java is the embedded language of choice for i-mode users. Sun has provided the KVM, a stripped down version of the VM made for small devices enabling to become more like multi-purpose machines.

Java programs have the ability to communicate with only the server of origin, must not communicate with other applications running on the handset, the JAM or Java Application Manager is separate also, to avoid malicious programs. The JAM is separate from the KVM. The CLDC provides an application level programmer interface. This API is a subset of the J2SE, or The Java 2 platform. The philosophy of Java on i-mode is that of a sandbox.

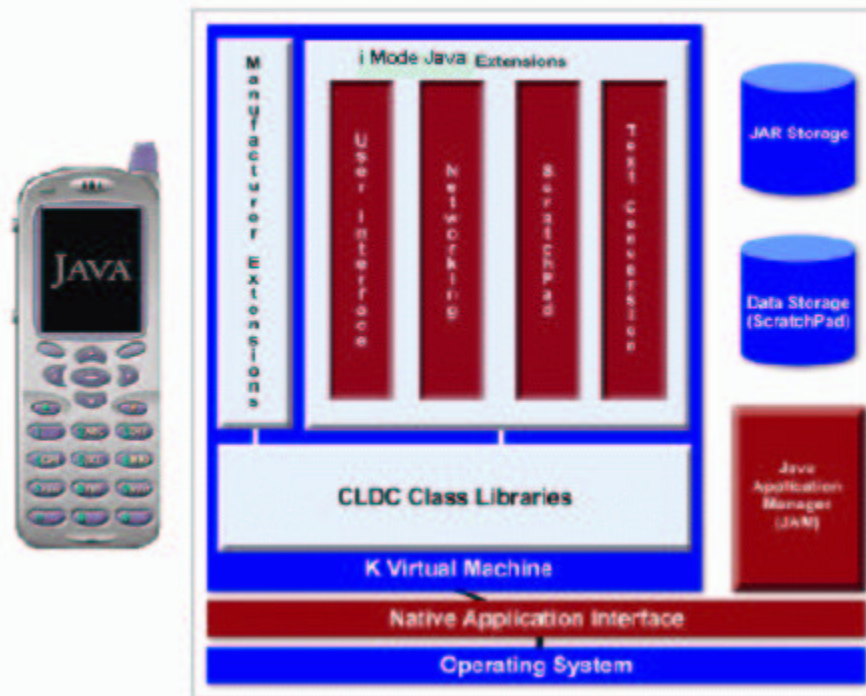
There is a wealth of development tools about, mainly on Windows OS's for Java and I-appli. The language is Java, so if you understand how to write for Java on one platform, and using the appropriate libraries, you should be able to program for Java on the i-mode handset.

A development tool called I-Jade provides an opportunity to develop for each handset. Other competitors claim different advantages to use their product and some such as Webgain's product are geared for Japanese users such that Japanese characters are used in the GUI interface.

An example of an I-appli package is ntt.docomo.ui. There are many others. The main source of development seems to be Java and I-appli based, as before. However, other companies like SEGA and Sony Entertainment are developing games. WapProfit has developed an i-mode editor (for iHTML) and, Macromedia has provided a Flash development kit, which means that this company is planning to port some aspects of Flash for the i-mode user.

The limitation of the handset is its memory size. However it is receptive to the download and processing of large files relatively fast, especially with 3G and 4G to come. It would be important for developers to cash in on the high bandwidth that many us have with high-speed Internet connections. Streaming video is one possibility. FOMA is one emerging technology that will allow developers to port new graphics into the i-mode handset. However the storage, either in volatile or non-volatile memory will become more of an issue as 4G networks download at 20+ megabits per second.

## The Architecture for the KVM or K Virtual Machine



The container that runs the programs on an i-mode handset is called the KVM, or K-virtual machine, and has a 128 KB memory footprint and was specifically designed from the bottom up for resource-constrained devices. It is supplemented by the Connected Limited Device Configuration with its component libraries, which run on the native code on the handset. The implementation of programming changes slightly for the implementers of the KVM for each handset. The KVM allows the user to run and download Java applications. Some examples are games, and visual effects. As said before, these can come from anywhere on the Internet where Java programs for the KVM exist. A development tool called I-Jade provides an opportunity to develop for each handset. There are slight differences between the functionality of handsets, which vary from company to company, and from year to year.

The future looks promising for i-mode in terms of development. Voice recognition technologies could be used to customize and personalize the users response in the future. As well, the possibility exists to extend functions such as c-mode, in order for a customer to have instant information on an item in a physical store before buying. With the camera on the handset, it may be possible to □ virtualize□ the world between a buyer and a seller, or between two subscribers. That is, they could be in several □ places□ but only in one physical location.

It is possible that video footage of say, one□ s face, that would allow two i-mode customers to see each other before they meet, or to display an impressive visual art to another subscriber. In the future, creating a video may be made easier, by the uploading of video from the i-mode handset to be stored in non-volatile memory.

## i-mode Business Model

NTT DoCoMo□ s business strategy provides i-mode with a competitive advantage in markets around the world. NTT DoCoMo, Japan□ s mobile industry leader is revolutionizing the mobile phone market with innovative ideas, such as i-mode. Through i-mode DoCoMo has been able to capture an industry leading 59.2% Japanese market share. The adaptive business strategy that i-mode incorporates will enable NTT DoCoMo to penetrate new markets and enhance the way people around the world live and work. This

is accomplished through i-mode's convenient low-cost mobile service that has already influenced 34+ million people across Europe and Japan. DoCoMo does not plan to limit i-mode's reach to just these two areas. In development are plans to enter markets in the North and South Americas, as well as the rest of the Orient. This global goal is achievable thanks to i-mode platform's ability to create unparalleled customer value for businesses, alliance partners, shareholders, and end-users. i-mode's success is attributed largely to NTT DoCoMo's involvement in all levels of the manufacturing, distribution, and retail chains as well as a strong commitment to R&D. By synchronizing the many different parties involved in creating, distributing, and market i-mode; NTT DoCoMo is able to guarantee that the i-mode experience evolves at an optimal pace, an offering that no other industry company can compete with. Because i-mode uses the most innovative mobile technology, DoCoMo is able to offer a wide variety of content at continuously increasing speeds. And because of i-mode's packet switched technology, NTT is able to offer service that is always on at a fraction of the usual (WAP) cost. And by constantly analyzing feedback NTT has been able to spawn the evolution of i-mode through FOMA. FOMA currently provides end users with unprecedented support for video and interactive games and businesses with a mobile SSL connection for critical day-to-day operations. Through its open exchange of technical data NTT to present the best content available along with the best industry performance. Content providers benefit from i-mode through NTT DoCoMo acting as an intermediary of fees. Thereby ensuring payments are made in full and on time. i-mode benefits shareholders by generating consistent capital through direct revenue from usage fees as well as major partnerships and the licensing of the NTT DoCoMo brand and technologies. Through its continuously expanding content i-mode is able to penetrate new market segments while retaining existing customers.

## Future of i-mode

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. Growth of i-mode is not limited to just Asia and Europe, as through its 9.87 billion dollar investment in AT&T Wireless, NTT DoCoMo plans to rollout an American i-mode service by 2002's end. 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. The market also has a strong belief in i-mode, even in the face of a 2002 fiscal year loss, investors still kept the stock at record levels. 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. What does this mean for NTT DoCoMo? 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 i-motion. During the second quarter of 2002 dual i-mode/WAP phones will begin to appear starting with the NEC N21i. These phones will provide users with both with the wide-reach of WAP content, as well as the efficiency and cost-effective i-mode services. 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.

## **i-mode Fee Structure**

i-mode pricing provides users with a cost-effective plan. Because i-mode is a package switched system fees are based on a per packet system. The current fee is 0.3 yen/128kbit packet + a base fee of 300 yen. + talk time fee of 1, 900 yen to 9, 200 yen.

Payments can be made over i-mode or through conventional payment systems.

### **Subscription Data**

	Mar 31, 2001	Dec 31, 2001	Mar 31, 2002
Cell Subscribers	36, 026, 000	39, 635, 000	40, 700, 000
FOMA subscribers	-	27,000	150,000
Voice ARPU	7, 700	6, 960	6, 960
i-mode ARPU	2, 110	2, 130	2, 210
i-mode subscribers	21, 695, 000	30, 182, 000	31, 700, 000
i-mode total revenue	45.7 trillion yen	64.3 trillion yen	70 trillion yen
Net increase	16, 092, 000	2, 413, 000	10, 005, 000
i-mode subscription rate (%)	60.2	76.1	78
Churn rate (%)	1.39	1.16	1.24

### **i-mode Pricing**

	<b>Yen</b>	<b>US Dollar</b>
<b>Monthly Fixed Rates</b>	300¥	\$2.48
<b>Packet Transmission Charges Per Packet (1 Packet = 128 bytes)</b>	0.3¥	\$0.0025
<b>Monthly I-mode Information Charges Per Site Subscription</b>	100¥ - 300¥	\$0.83 - \$2.48

<http://www.imodelinks.com>  
<http://www.palowireless.com/imode>  
<http://www.mobilemediajapan.com>  
[http://www.nttdocomo.com/html/subscriber\\_growth.html](http://www.nttdocomo.com/html/subscriber_growth.html)  
<http://www.google.com/search?hl=en&q=i-mode>  
<http://www.eurotechnology.com/imode>  
[http://www.nttdocomo.co.jp/english/p\\_s/java/eng\\_jguide\\_rell1.pdf](http://www.nttdocomo.co.jp/english/p_s/java/eng_jguide_rell1.pdf)  
<http://news.zdnet.co.uk/story/0,,t412-s2107155,00.html>

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