# 세종대왕의 발명: 한글과 실시간 한민족 정보 네트워크

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## 요 약

인터넷, 특히 모바일 인터넷이 인류사회의 많은 분야, 특히 지식정보의 교환 속도에서 큰 영향을 끼치고 있다. 새로운 지식정보사회는 가치 있는 지식과 정보를 기반으로한 많은 새로운 서비스 형태를 출현 시킬 것이다. 모바일 환경에서의 많은 새로운 서비스 중, 유선과 모바일 인터넷을 이용해서, 세종대왕이 창제한 한글을 이용한 실시간 전세계 한민족 네트워킹 서비스가 언제 어디에서나 가능하게 되었다. 모바일 환경에서 한글을 이용한 유저 인터페이스를 연구하였고, 또한 한글 도메인 명을 사용하여 실시간 한민족 정보 네트워킹을 실제 구현한 유용한 결과를 새로운 성능분석 메트릭과 함께 소개한다.


# King Sejong's Invention: Korean Characters and Real-time Korean Information Network

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## ABSTRACT

The Internet, especially the mobile Internet influences enormously in many areas in human society, especially in terms of the exchanging speed of knowledge and information. This new society of knowledge and information will introduce many new types of services based on valuable knowledge and information. Among many new services in this mobile computing environment, the real-time worldwide Korean information networking service using the Korean characters invented by the King Sejong is possible ubiquitously with wired and mobile Internet. We studied the user interface with Korean characters in the mobile computing environment, and introduce the useful results with new metrics of performance analysis after real implementation for real-time Korean information networking using Korean domain names.


**키워드 : Mobile Internet, Korean Alphabet and Korean Characters, Information Network**

## 1. Introduction

Exchanges of information, with speech and characters, have evolved the human society enormously since the ancient age. Recently, one hundred of great people, who had influenced the global human society during last millennium since the year of A.D. 1000, were chosen by a group of American leaders and introduced in the History TV channel. Among the one hundred great people, Mr. Gutenberg, the German who invented the printing technology in the year of 1455, was elected as the number one in the ranking, the second person in the rank was Mr. Isaac Newton, the great scientist.

In the mid-fifteenth century Johannes Gutenberg [1] invented a way of mechanizing the production of printing type, as distinct from individually engraved or cast letters. This was the beginning of the mass production of books. The Gutenberg Bible was printed in Mainz around 1454-5. It is the first major book printed in the west, and about 180 copies were printed and significant parts of 48 copies still survive.

In Korea, Jikji [2] is the first book published using metal printing method in the year of 1377. Dating 78 years back from Gutenberg's '42-line bible', the western hemisphere's proud tradition, Jikji is the manifestation of the advanced printing technology and flourishing publishing culture in late Goryeo Dynasty. UNESCO, a UN organization, instituted "Memory of the World Program" to protect and preserve "written legacies." In September 4, 2001, Jikji is listed on Memory of the World program.

King Sejong [3] the Great is regarded as the most enlightened king in Korean history. King Sejong was born in 1397, and ascended the throne in 1418 at the age of 21. During his 32-year reign, King Sejong energetically promoted learning. He was responsible for the creation of the Korean Hangul alphabet, and this scientific alphabet is his most known achievement; the Korean alphabet composed of 28 Korean characters were invented by the King Sejong himself in the year of 1443. This alphabet enabled literacy to become more available to the general population, who could not be expec-

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논문접수 : 2003년 7월 18일, 심사완료 : 2003년 9월 17일

ted to master the classical Chinese language that was the official written language of Korea at the time. In 1420, King Sejong established the Chipyon chon (Hall of Worthies), a royal research institute. He gathered the foremost scholars and writers of the time and had them compile some 20 works on history, geography, astronomy, mathematics, military science, pharmacology, and agriculture. These also included encyclopedias on Chinese medicine and Korean medicine (hanyak). Of the many valuable books that were published during his reign, a collection of King Sejong's own poems praising Buddha entitled Worin Chon-gangjigok were also published.

The wired Internet introduced in the last decade of 20th century, i.e. at the just ending period of last millennium, has influenced many areas in human society, especially the speed of knowledge and information exchange; the mobile Internet is affecting much more in ubiquitous computing environment and will introduce many special applications in this 21st century. This new age of knowledge and information derives also many new aspects of human life and business model, and the worldwide real-time racial information network based on the access of Internet, both the wired Internet and mobile Internet, becomes realistic especially using the multilingual Internet domain names and related contents, e.g. Korean Domain Names using Korean characters invented by King Sejong.

For wired Internet using HTML, for PCs, and for mobile Internet using WML, mHTML or HDML, for mobile phones, the management of server becomes more difficult. The mobile clients-server web applications with a real-time requirement were studied and the study for the overall system performance considering the case of writing web pages were left for further study [4]. For the mobile phone Internet, as one of major protocols, the WAP protocol has been used a lot, especially in Korea and many other countries, and WAP browsers, with WAP 1.0 to WAP 2.0 version, have been implemented in many mobile phone devices. The challenged performance in the ubiquitous mobile computing [5] is what the bottlenecks in the application architecture or the content path are.

So many different kinds of portals and web sites might give some confusion for some unified application like worldwide racial networking even though they have given us many valuable applications. We introduce the real-time unified portal for worldwide racial information network based on wired and mobile Internet, and show the useful results from real implementation for Korean information network using Korean domain names.

## 2. Korean Characters and Mobile Internet

The usefulness of the Korean domain names, as a multilingual domain name, was studied. Especially the convenience of the single Korean character and Korean Alphabet as a URL or domain name was studied, e.g. 'ㅇ].net', 'ㄱ.com', and 'ㅏ.com' etc. For the real-time service, the speed for typing URL, here Korean domain name, will be one of the dominating factor in performance especially for Korean mobile phone users in near future. The single Korean character is meaningful because every word or acronym as a domain name starts from a single Korean meaningful character as well as from a Korean consonant alphabet.

The user interface to type-in the domain name for the access of Internet, both the wired Internet and the mobile Internet, should be as simple as possible. The single character, here, the Korean character, satisfies the convenient user interface for the wired and mobile Internet. The scheme for multilingual domain names including Korean domain name has been standardized world-widely by IETF and is being approved by ICANN [6]. The multilingual domain name service using plug-in program, which is converting the Korean domain name to ASCII code, has been serviced since January 2003.

The performance of the unified portal is important to provide services with cost-effective and inexpensive system solution. Therefore, we considered the requirement for performance and its metrics in the pervasive computing environment. We introduce the real-time Korean information network, based on Korean domain names, and shows also the useful results of implementation of the unified portal for worldwide Korean information networking, using Korean characters invented by the King Sejong in the year of 1443.

For the consistency of information and for the convenient user interface, we need the unified portal for wired Internet and mobile Internet. The real-time access of information, knowledge and advertisement is required for many applications, e.g. location based services and mobile commerce services and so forth. Also, we need to write the information or advertisement in real-time way. Even though the convenient access and search of required information in many information portal sites using search engines based on server clustering architecture [7], the writing of information or advertisement of web sites or special notices is difficult or not possible, especially in terms of real-time way.

With proliferation of pervasive computing devices, the Internet applications should be integrated into existing social systems [8]. There are so many different kinds of portals

that are based on the wired or mobile Internet, and also many community sites are proliferating. However, the complexity of consistent information access from the portal or community sites has been increasing, in other sense the isolated information islands may increase continuously, e.g. the mobile portal sites managed by the mobile communication operators, e.g. in Korea. We suggest the unified portal using Korean domain names for the above situation and the information anarchism, e.g. numerous immoral sites, should be expelled from this promising information super highway.

The unified web server should have the capability of showing the appropriate contents, i.e. the HTML contents for wired Internet as well as the mobile contents for many different kinds of mobile devices, e.g. WML, mHTML, HDML, etc. For unified service, there are several constraints, compared to the contents for the wired Internet. Therefore the development and application environment are very different from the existing wired Internet environment, i.e. mainly based on MS Explorer as an Internet browser.

We suggest the minimum requirements as capabilities of unified Web server instead of luxurious capabilities, because of the cost-effectiveness and low cost/performance ratio. To provide the minimum requirement for the wired Internet using PC and for the mobile Internet for the wireless mobile devices, e.g. handheld devices and mobile phones, we can provide the simplest functionality with the less capable mobile Internet phone. Among several constraints with mobile phone, in terms of the contents, the WML deck size should be below around 1.5Kbyte, even though recently several models for the CDMA 1x EVDO with 2mbps speed have been introduced in the Korean mobile services, e.g. 'June' service by SKT and 'Fimm' (First in Multimedia Mobile) service by KTF and the deck size over 4.5Kbyte is bigger than old models. We implemented the suggested unified portal of Korean Information Network for wired Internet for PC and wireless Internet for mobile devices. The size of contents is below 1.5Kbyte as a WML deck, which is the transmission packet unit in the WAP environment; and even for the wired Internet the packet size is almost same for unified service. The easy typing of the URL was also considered for both wireless and wired Internet. The Korean domain names, which become the key for retrieval of information or registration of information as well as advertisement, were considered as a user interface for Korean information networking. Moreover, for real-time writing of contents with mobile phone, the speed of typing-in with keypads in the mobile phone was studied using Korean characters and Korean alphabet invented by King Sejong.

## 3. User Interface with Mobile Phone

To access pervasively this unified portal for Korean information network, as we mentioned already, the user interface should be as convenient as possible even for typing-in the domain names or URLs as well as for typing-in the contents with mobile phone.

<Table 1> Average Keypad Press Number

(LG Wever-net Model)

| Press No | Alphabet | Probability | (Mean) Press Number |
|---|---|---|---|
| 1 time | a, d, g, j, m, p, t, w | 8/26 | 8/26 |
| 2 times | b, e, h, k, n, q, r, u, x | 9/26 | 18/26 |
| 3 times | C, f, i, l, o, s, v, y, z | 9/26 | 27/26 |
| | Average Keypad Press Number for English Alphabet | | 53/26 = 2.04 |

About the user interface, <Table 1> shows the average of the keypad press number in the case of LG's Wever-net model. Based on the assumption of single English alphabet character, this is analyzed at the user's point of view. For writing the information in real-time way, the user's typing speed of character is one of important performance factors, especially with the mobile phone.

<Table 2> Average Keypad Press Number

(LG i1500 Model)

| Press No | Alphabet | Probability | (Mean) Press Number |
|---|---|---|---|
| 1 time | a, d, g, j, m, p, t, w | 8/26 | 8/26 |
| 2 times | b, e, h, k, n, q, u, x | 8/26 | 16/26 |
| 3 times | c, f, I, l, o, r, v, y | 8/26 | 24/26 |
| 4 times | s, z | 2/26 | 8/26 |
| | Average Keypad Press Number for English Alphabet | | 56/26 = 2.15 |

In the <Table 2>, the other model by LG Telecom in Korea, LG-i1500 shows the average about 2.15. Among many other models from other vendors in Korea, the Anycall model by Samsung in Korea shows that the average keypad press number is about 2.04.

<Table 3> Average Keypad Press Number

(LG i1500 Model)

| Press No | Korean Character | Probability | (Mean) Press Number |
|---|---|---|---|
| 1 time | ㄱ, ㄴ, ㄹ, ㅂ, ㅅ, ㅇ | 6/14 | 6/14 |
| 2 times | ㅋ, ㄷ, ㅂ, ㅈ, ㅎ | 5/14 | 10/14 |
| 3 times | ㅌ, ㅍ, ㅊ | 3/14 | 9/14 |
| | Average Keypad Press Number for Korean Alphabet | | 25/14 = 1.76 |

For Korean alphabet of 14 consonants, LG-i1500 model shows the averaged Keypad Press Number is about 1.76 as shown in <Table 3>. The other models from SK and Samsung show the average about 1.5 for both models as shown in <Table 4> and <Table 5>. We could see that the Korean alphabet is easy to type with mobile phone.

〈Table 4〉 Average Keypad Press Number

(SK SKY cdma2000 Model)

| Press No | Korean Character | Probability | (Mean) Press Number |
|---|---|---|---|
| 1 time | ㄱ, ㄴ, ㄷ, ㅁ, ㅂ, ㅈ, ㅇ | 7/14 | 7/14 |
| 2 times | ㄹ, ㅅ, ㅊ, ㅋ, ㅌ, ㅍ, ㅎ | 7/14 | 14/14 |
| | Average Keypad Press Number for Korean Alphabet | | 21/14 = 1.5 |

〈Table 5〉 Average Keypad Press Number

(Samsung Anycall Model)

| Press No | Korean Character | Probability | (Mean) Press Number |
|---|---|---|---|
| 1 time | ㄱ, ㄴ, ㄷ, ㅂ, ㅅ, ㅈ, ㅇ | 7/14 | 7/14 |
| 2 times | ㄹ, ㅁ, ㅊ, ㅋ, ㅌ, ㅍ, ㅎ | 7/14 | 14/14 |
| | Average Keypad Press Number for Korean Alphabet | | 21/14 = 1.5 |

About the user interface for single Korean character, the following <Table 6> shows the average of the keypad press number in the case of LG's Wever-net model. Based on the assumption of single Korean character composed of one consonant and one vowel; this is analyzed for the user's point of view and the average is around 3.86.

〈Table 6〉 Average Keypad Press Number

(LG Wever-net Model)

| Press No | Consonant and Vowel | Probability | (Mean) Press Number |
|---|---|---|---|
| 1 time | ㄱ, ㄷ, ㅁ, ㅅ, ㅈ | 5/14 | 5/14 |
| | ㅏ, ㅓ, ㅡ, ㄱ, ㅣ | 5/14 | 5/14 |
| 2 times | ㄴ, ㄹ, ㅂ, ㅇ, ㅊ | 5/14 | 10/14 |
| | ㅐ, ㅔ, ㅗ, ㅠ, ㅖ | 5/14 | 10/14 |
| 3 times | ㅋ, ㅌ, ㅍ, ㅎ | 4/14 | 12/14 |
| | ㅟ, ㅢ, ㅛ, ㅒ | 4/14 | 12/14 |
| | Average Keypad Press Number for Single Korean Character (1 consonant and 1 vowel) | | 54/14 = 3.86 |

The other model by LG Telecom in Korea, LG-i1500, shows the average about 3.93. Among many other models from other vendors in Korea, The 'Chon-Ji-In' model by Samsung in Korea shows that the average keypad press number is about 4.07. Similarly, in the <Table 7>, the SKY model IM-6200 by SK Telecom in Korea, shows that the average is about 4.14. In the case of single Korean character composed of two consonants and one vowel, the results will be changed.

〈Table 7〉 Average Keypad Press Number

(SK SKY IM-6200 Model)

| Press No | Consonant and Vowel | Probability | (Mean) Press Number |
|---|---|---|---|
| 1 time | ㄱ, ㄴ, ㄷ, ㅁ, ㅂ, ㅇ, ㅈ | 7/14 | 7/14 |
| | ㅏ, ㅓ, ㅗ, ㅜ, ㅣ | 5/14 | 5/14 |
| 2 times | ㄹ, ㅅ, ㅊ, ㅋ, ㅌ, ㅍ, ㅎ | 7/14 | 14/14 |
| | ㅑ, ㅕ, ㅛ, ㅠ, ㅡ, ㅐ, ㅒ | 7/14 | 14/14 |
| 3 times | ㅋ, ㅌ, ㅍ, ㅎ | 4/14 | 12/14 |
| | ㅒ, ㅖ | 2/14 | 6/14 |
| | Average Keypad Press Number for Single Korean Character (1 consonant and 1 vowel) | | 58/14 = 4.14 |

The Korean domain name is consisted of several characters where the each character is at least composed of one consonant and one vowel; that means the minimum bound of keypad pressing number for single Korean character is the same as we discussed above. Therefore the minimum bound of keypad pressing number for Korean domain names, in the case of several Korean characters, will be the multiple of the above keypad pressing number.

The English domain name is at least consisted of several alphabet characters; that means the minimum bound of keypad pressing number for single alphabet character is the same as we discussed above. Therefore the minimum bound of keypad pressing number for English domain names, in the case of using several alphabets, will be the multiple of the above keypad pressing number. For example, our unified portal site 'ktrip.net', the actual keypad pressing number with the above LG-i1500 model is around 20 including the mode change from Korean mode to the English mode; in the case of the portal site 'yahoo.com', the keypad pressing number is around 22. The number of keypad pressing '.net' itself is 6 and the keypad pressing number for '.com' itself is 8 for both LG models. For Korean domain '.kr', the keypad pressing number is 6. Therefore we might need the one-touch button in the mobile phone, for '.net', for '.com' and '.kr'.

Evaluating servers with commercial workloads becomes more difficult [9]. We used single web server as a unified portal service for the simplicity of management and the cost-effectiveness. This method gives the effectiveness and efficiency for the notification of information and utilization of resources, in terms of the bandwidth for communication and the size of disk storage

Instead of the traditional performance analysis [10], for the

mobile user in the ubiquitous computing environment, we could consider the following delay metric. The round-trip response time for user's single interaction, from user to the contents in DB through wired/mobile Internet before next interaction, with mobile phone is $r_m$, which is composed of the time for user's preparation to get mobile phone in his hand is $U_m$ ; the time spent with mobile phone to do appropriate action for service is $D_m$ ; the aggregate time to the web Server after the mobile device through wired/mobile Internet for mobile service is $S_m$(the network time is included here) ; the time depending upon mobile contents is $C_m$ . Among the above random variables ($U_m, D_m, S_m, C_m$) for mobile user, the most dominating factor, i.e. the random variable, may be different from person to person. From our study, we can order the dominating random variables, as follows, $U_m > D_m > S_m > C_{m(write)} > C_{m(read)}$.

This relation may be changed from person to person, from contents to contents, but our main concern is how to make the dominating times to be shortened.

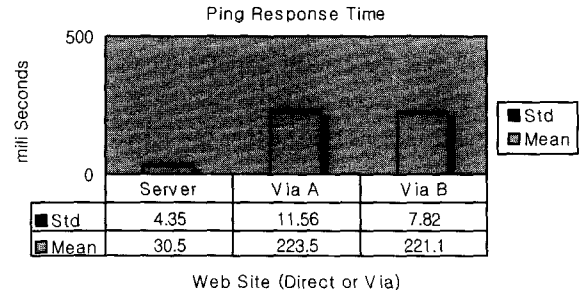
For the real-time application using wired Internet and mobile Internet, the dominating factor and the variance of that random variable should be bounded within the deterministic response time. To be deterministic for real-time application, the user should be skilled, the user interface of device should be convenient, the server should be efficient and have high performance for the dedicated application if possible, and finally the contents should be simple as possible with simplified and efficient format. The user's preparation time $U_m$ will be shortened depending upon the proliferation of pervasive devices, e.g. mobile Internet devices.

Let's consider the average of the keypad press number for the case of LGT's, Samsung's and SKT's model, discussed before, and this is related to the device time $D_m$. Based on the assumption of single Korean character composed of one consonant and one vowel ; this is analyzed at the user's point of view. For writing the information in real-time way, the user's typing speed of Korean character is one of important performance factors. The Korean characters or alphabet is simpler than English characters or alphabet in the case of same condition.

## 4. Empirical Results

This system is based on wired or mobile internet, many single Korean character domains for fast access to the required Korean domain name, the required information or advertisement can be registered in any time and any place using wired or mobile Internet [11] with the single Korean character domain name, e.g. '수.net', '고.net', 'ㄱ.com', 'ㄴ.com' etc. The implemented system is as follows; for the operating system, Windows 2000 server; for wired and mobile Internet web services, IIS5.0 web server and ASP 3.0; for DBMS, MS SQL server; for the mobile markup language, WML for SK Telecom, mHTML for KTF, HDML for LG Telecom. The E1 (2.048Mbps) Internet communication line to the web server, i.e. the unified portal, for both wired and mobile Internet service, is being used, because this E1 or T1 line is most popular and cost effective for many small and medium size companies. As we discussed already, the size of web page for unified service was considered below 1.5Kbyte, i.e. between 50Bytes and 1.5Kbytes, to minimize the dependency of the overall performance to the shared and stochastically varying network traffic; also the web server is dedicated to minimize the server load, and dedicated for the unified portal for Korean information networking.

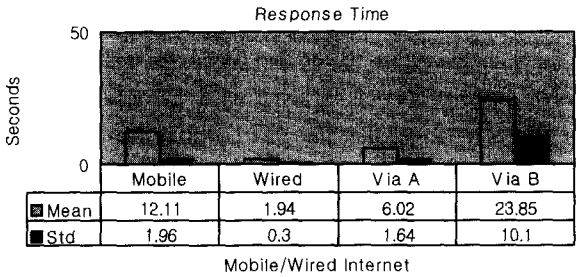
The speed of real-time registration of advertisement as well as the speed of access of special information for various communities is fast enough for real application. Moreover the effectiveness and efficiency of storage for advertisement and information is being anticipated if we consider the inefficient worldwide applications, e.g. various community sites, home pages for small companies, or inconvenient notification boards, as far as the consumed disk storage, operation and administration are concerned.




(Figure 1) Response Time with Ping Command

(Figure 1) shows the response time after Ping command from wired PC to the unified server (ktrip.net) directly, via A site ('ㄱ.com', web forwarding service server A of domain registrar), and via B site ('수.net', similarly, the web forwarding service server B of domain registrar). We can observe that the direct access to the server without any intermediate server is rather faster than the others, via A and via B. (Figure 2) shows the mean and standard deviation of around 100 samples gathered in June 2003, we can observe that the response time at wired PC is fastest and stable with

little deviation, the averaged response time with mobile phone Internet is around 12 seconds with about 2 second standard deviation, the other two cases with wired PC via the intermediate server in domain registrar office show that depending upon the intermediate server the mean and deviation of the response time become very different.




(Figure 2) Response Time (Mean and Standard Deviation)

The size of one web page for wired Internet is around 25Kbytes, and the notations are marked with Via A (for 'ㄱ.com') and Via B (for '수.net') in (Figure 2). The size of web page for the wired Internet accessed by the domain name ktrip.net is about 5Kbytes, and the size of the mobile web page (uncompiled) is about 1.5Kbytes which become about 1Kbytes after compiling to WAP binary file. For example, the uncompiled 1639Bytes becomes 988Byte WAP binary, the uncompiled 993Bytes becomes 662Byte binary, the uncompiled 1Kbyes becomes 650Byte binary (compiled WAP binary), respectively.

With the (Figure 1) and (Figure 2), we can conclude that the network and server response time for Ping command is much shorter than the content retrieval time in the server. The mobile 1.5Kbyte content retrieval time with mobile Internet is about 10 seconds longer than the wired (PC) 5Kbyte content retrieval time.

## 5. Conclusions

A real-time unified portal using Korean domain names has been implemented for worldwide real-time Korean information network, based on wired and mobile Internet. The results of implementation show the usefulness and convenience for the society of knowledge and information, with Korean alphabet invented by King Sejong in the year of 1443.

The analysis of the unified portal for the wired and mobile Internet using Korean characters and alphabet was discussed, considering the effective response time for worldwide service. As one of future works, the use of Korean domain names by mobile operators will be promoted to reduce the speed of domain names, and the effects to the mobile customers will be studied in terms of the real-time exchanging speed of knowledge and information.

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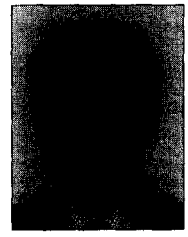

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