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**ARABIC DOMAIN NAMES SYSTEMS (ADNS)  
REQUEST FOR COMMENTS**



United Nations  
New York, 2003

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## Abstract <sup>1</sup>

There has been several attempts aiming at Arabization of Domain names to be in Arabic language and using Arabic characters. To satisfy this demand, an entire environment needs to be developed in order to take into account technology standardization, policy and administrative arrangements, as well as new applications.

So far, there has been a vacuum in the coordination process pertaining to the development of Arabic Domain Names, leading to uncoordinated competition on standards and creating a state of uncertainty. In the beginning of the second quarter of 2003, an “Arab Domain Names Task Force” (ADNTF) was formed under the auspices of ESCWA; one of its main objectives is to help define standards for ADNS through this “Request For Comments” (RFC) document.

In this RFC, many technical and linguistic issues are resolved, including the adoption of the domain names system based solution with client approach to domain names resolution; the syntax of the proposed Arabic Domain names together with the character set and many Arabic-language specific issues were also adopted from the most recent studies in this field. The RFC proposes standards that are compatible with the Internet Consortium for Assigned Names and Numbers (ICANN) and the Internet Engineering Task Force (IETF) as far as Domain Names System (DNS) and Internationalized Domain Names (IDN) standards are concerned.

An extension to this RFC may also include issues related to other languages based on Arabic script (e.g., Urdu and Persian) together with policy and intellectual property issues as well. It is strongly recommended to receive constructive feedback on this RFC in order to enhance it and reach a consensus on the major issues in the very short term.

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<sup>1</sup> This document has been printed without formal editing and the views expressed in this document do not necessarily reflect the opinion of UN-ESCWA.

The UN ESCWA currently provides the funding for development of this RFC with the purpose of proposing a standard for a comprehensive Arabic domain Names System (ADNS) and requests discussion and suggestions for improvements. Technical, management, operation and language specific issues are discussed and recommendations are made. Distribution of this memo is unlimited. Suggestions for improvements, amendments or addition are welcome. Please send comments to Mr. Ayman El-Sherbiny [el-sherbiny@un.org](mailto:el-sherbiny@un.org).

Thanks are due to Dr. Abdel-Aziz Al-Zoman and to Mr. Wael Nasr Abel-Ati for contributing to this document; to Mr. Khaled Fattal, the President of the MINC for his persistent efforts in the field of Multilingual Domain Names, to Mr. Charles Shaaban of Talal Abu-Ghazaleh International Society (TAGI) for his efforts in the Policies aspects of Arabic Domain Names and to SaudiNIC of KACST for its continuous efforts in the field of supporting Arabic Domain Names.

# CONTENTS

	<i>Page</i>
Abstract .....	ii
Introduction .....	1
<b>I. EVOLUTION OF ARABIC DOMAIN NAMES .....</b>	<b>2</b>
A. DYNAMICS OF THE ELAPSING PHASE .....	2
B. THE MILESTONE .....	4
C. REVITALIZATION OF THE REGIONAL EFFORTS .....	4
<b>II. ARABIC LANGUAGE SPECIFIC ISSUES .....</b>	<b>5</b>
A. LINGUISTIC ISSUES .....	5
B. SUPPORTED CHARACTER SET .....	6
C. ARABIC DOMAIN NAME STRUCTURE .....	8
D. RECOMMENDED ARABIC TLDS AND CCTLDS .....	8
E. ARABIC LINGUISTIC ISSUES AFFECTED BY TECHNICAL CONSTRAINTS .....	9
<b>III. THE SOLUTION CONCEPT .....</b>	<b>11</b>
A. DNS-BASED SOLUTION .....	11
B. CLIENT-SIDE APPROACH .....	11
<b>IV. OPERATIONAL ASPECTS.....</b>	<b>12</b>
A. REGISTRAR-RELATED ASPECTS.....	12
B. THE NETWORK STRUCTURE AND COMPONENTS .....	12
<b>V. CONCLUSION, RECOMMENDATION AND OPEN ISSUES.....</b>	<b>16</b>
A. CONCLUSION .....	16
B. RECOMMENDATIONS .....	16
C. OPEN ISSUES .....	17
References .....	18

## LIST OF TABLES

1. Characters From Unicode Arabic Table (0600--06 FF) .....	6
2. Characters From Unicode Basic Latin Table (0000—007F): .....	7
3. Proposed Arabic ccTLDs .....	10

## LIST OF FIGURES

1. The context of Arabic Domain Names .....	2
2. Domain Name Systems and Languages .....	3
3. Different approaches for resolution of Multilingual Domain Names.....	11
4. Root Servers, and domain resolution Diagram .....	13

## ANNEXES

I. DNS technology .....	19
II. Multilingual DNS technology structure .....	22
III. IDN Standard.....	23
IV. IETF and ICANN recommendations.....	25
V. Differences Between IDN and Keywords.....	26

## ABBREVIATIONS AND ACRONYMS

ADNS	Arabic Domain Names System
ccTLD	Country Code Top-Level Domain
DNS	Domain Names System
GTLDs	Generic TLDs
ICANN	Internet Corporation for Assigned Names and Numbers
ICT	Information and Communication Technology
IDN	Internationalized Domain Names (s)
IETF	Internet Engineering Task Force
MINC	Multilingual Internet Names Consortium
MLDN	Multilingual DNS technology
RFC	Request for Comments
SaudiNIC	Saudi Network Information Center
TAGI	Talal Abu-Ghazaleh International Society
TLD	Top-Level Domain

## **Introduction**

The Arab region suffers from a digital divide that is mostly manifested in the form of the lowest regional Internet usage rate in the world. "Language" is identified to be one of the main barriers to widespread Internet usage.

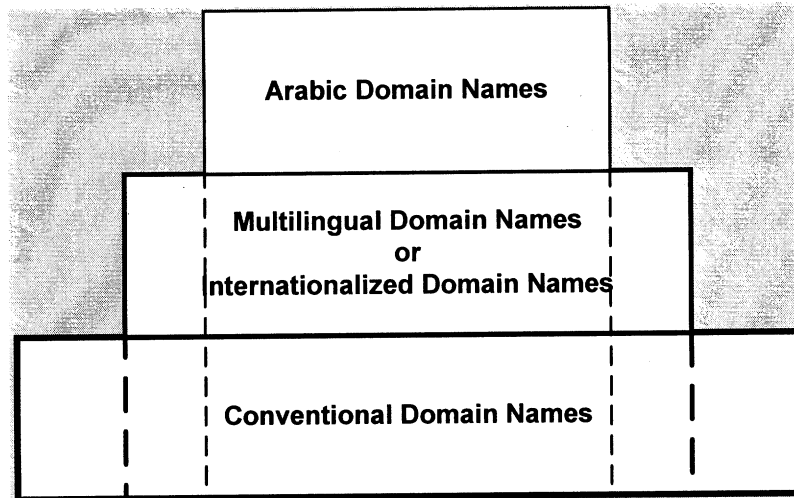
Along with the attempts to increase the volume of Arabic content on the Internet, there has been also several attempts aiming at Arabization of Domain names themselves to be in Arabic language and using Arabic characters. These attempts, when completely successful, will create the thrust for a second wave of Internet spread across the Arab region.

The future of Arabic Internet names is imminent; there is substantial market and user demand for Arabic domain names. To satisfy this demand, the entire environment will need to be developed to take into account technology standardization, policy and administrative arrangements, as well as new applications. The significance of these efforts should not be underestimated, as it is part of a far nobler goal: the ongoing internationalization of the Internet.

# I. EVOLUTION OF ARABIC DOMAIN NAMES

The efforts exerted so far to define an Arabic Domain names System were not done in isolation of the world; they were exerted within the context of the global movement of Internationalized Domain Names (IDNs) and Multilingual Domain Names (MLDNs). Most of these IDNs or MLDNs were also developed within a wider framework of the Domain Name Systems (DNS) as depicted in Figure (1).

**Figure 1. The context of Arabic Domain Names**



In the conventional Domain Name systems, one has to differentiate between three types of players: (a) organizations, (b) technology providers and (c) service providers namely Registries/Registrars. Each of those three types of players is responsible for a different set of goals and is normally undertaking a special set of activities.

## A. DYNAMICS OF THE ELAPSING PHASE

### 1. Global Evolution

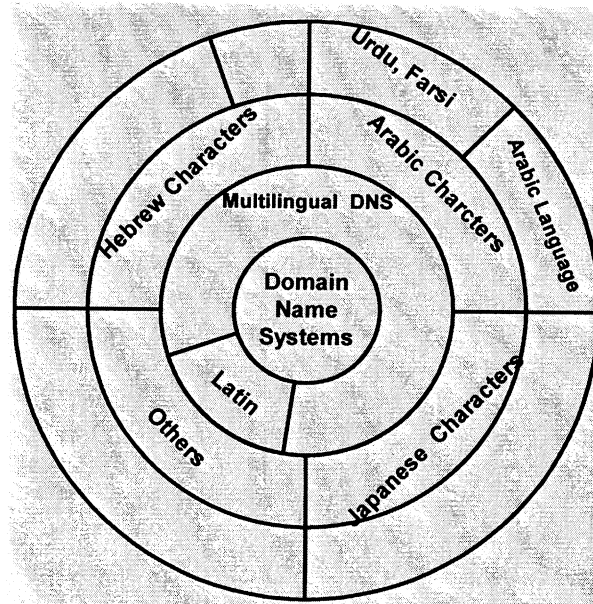
During the elapsing five years, the evolution of multilingual domain names was not easy. While the Internet Consortium for Assigned Names and Numbers (ICANN) was evolving, it was naturally occupied by reorganization issues related to the entities responsible for coordinating the development of the conventional Internet. Such occupation some temporary vacuum in the field of Multilingual Domain names and left a room for uncoordinated competition on standards, thus creating a state of uncertainty especially for the Arabic language.

Generally, multilingual domain names activities and efforts started in Eastern Asia, by Korean, Chinese and Japanese languages much earlier than the Arabic language; where a multitude of technology providers, registries and registrars emerged. Figure (2) depicts the different languages with the corresponding character sets and their relationship to the DNS.

Technologies differ amongst different providers mainly in terms of the mechanism they use the “client” – “server” relationship, in addition to the differences in the character-set and the language script itself.



**Figure 2. Domain Name Systems and Languages**



## *2. Regional Evolution*

During this elapsing period, implementations of the Arabic Domain Name system varied enormously amongst technology providers and their respective registries. Those technology providers competed harshly in order to “impose” standards on the community, and to create a status quo that they can use it to reinforce their position and also to gain profits to sustain their innovation cycle.

The battle created a chaotic situation and standardization was not achieved; “Registries” were technology-centric taking the risk of adhering to standards and/or technologies that may become obsolete in a very short term and consequently risking the sustainability of the “domain names” of their end-users. Further to this, the uniqueness of an “Arabic domain name” on the Internet is currently not guaranteed; so two entities/persons can register the same name on two different registries!

On the other side, many registries refused to implement any solution before standards are enforced by an independent authority; consequently, most of the technology providers couldn’t secure enough clients due to the chaotic situation that was dominant and some of them went out of business.

There was a hope to depend on the so-called Arab Internet Names Consortium (AINC) to play the role of the coordinating body, but unfortunately, it couldn’t due to some internal conflicts. Such absence of a strong regional coordinating body in addition to the absence of an effective role of ICANN resulted in a situation that led to stagnancy in the field. Hence, by the start of 2003, the situation was as follows:

- Lack of awareness amongst professionals and consumers about the viability and importance of Arab Domain Names in general;
- Time and effort were wasted in competing technologies and competing standards that exhausting resources and draining the energy of the small emerging ADNS companies;
- Accumulated expertise in this field; in spite of frustration and need for re-alignment;

- The absence of a coordinating body that can play the role of a moderator and catalyst at the same time contributed to the distraction and uncoordinated movements amongst players.

## B. THE MILESTONE

The Internet Engineering Task Force (IETF), one of the most respectable bodies and the most adhered to Internet Engineering Community issued in March 2003 a set of standards for Internationalized Domain Names -see [4,5,6] and (annex III)- that are supposed to become the de facto standard for all languages.

This event is considered as a milestone in the evolution of the multilingual domain names sub-industry. From this milestone on, the battle of standards will be possible to get finally resolved to a great extent, technology providers who will emerge will not compete on standards anymore but will compete on efficiency and cost of the technology. All registries and registrars will be compatible and most importantly domain names themselves will be unique as they should.

## C. REVITALIZATION OF THE REGIONAL EFFORTS

In the beginning of the second quarter of 2003, UN ESCWA considering the potential and impact of the ADNS, called for an Expert Group Meeting (EGM) at the UN House in Beirut, during June 3-5, 2003 to set a new roadmap for development of the Domain Names industry and to discuss activities required to establish standards for the Arabic Domain Names, identifying obstacles and setting objectives and initiatives for the promotion of the Arabic Domain Names System in a coordinated fashion.

Upon the recommendations of the participants, an Arab Domain Names Task Force (ADNTF) was formed under the auspices of ESCWA, with the following objectives:

- Raising awareness among stakeholders about the importance of the Arabic Domain Names System (ADNS);
- Defining standards for ADNS through a "Request For Comments" (RFC) document;
- Promoting the adoption of standards in a coordinated fashion;
- Obtaining global recognition for the adopted standards;
- Facilitating deployment of these standards by the various stakeholders.

The current phase is concerned with defining a set of agreeable and consistent standards for ADNS, which are compatible with existing domain naming standards. Producing this set of standards is a necessity in the process of streamlining the efforts of the region in the same direction.

Publishing this RFC aims at obtaining feedback and comments that will lead to worldwide recognized standards.

## II. ARABIC LANGUAGE SPECIFIC ISSUES

The main objective of the creation of an Arabic Domain Names System is to have a vehicle to facilitate Internet use amongst all strata of the Arab speaking communities. If the structure or hierarchy of the ADNS does not meet certain core criteria, then the intended wide-scale dissemination of the Internet would be hampered.

Furthermore, an ADNS, which is not user friendly, would further add to the ambiguity and the eccentricity of the Internet to the Arab speaking communities, thus contributing negatively to the dissemination of the Internet and leading to further isolation of these communities at the global level.

Hence, there have been intensive efforts especially those spearheaded by Dr. Al-Zoman and recently contributed to by ESCWA to reach some consensus on a multitude of linguistic issues with the following goals:

1. To define the accepted Arabic character set to be used for writing domain names in Arabic;
2. To define the top-level domains of the Arabic domain name tree structure (i.e., Arabic gTLDs, and ccTLDs).

As indicated in the studies carried out by Dr. Al-Zoman [7] and [8] and by UN ESCWA, there are many valid criteria to evaluate the proposed Arabic generic top-level domains gTLDs, or the Arabic country code top-level domains ccTLDs namely:

- (a) Length of the generic Top-Level Domain (gTLD) or the Country Code Top-Level Domain (ccTLD);
- (b) Coherence and clarity;
- (c) Consistency with the Arabic language;
- (d) Easiness of pronunciation;
- (e) Extendibility.

In addition to the above-mentioned criteria, and in order to achieve wide-scale dissemination, it is necessary to ensure two main characteristics of the overall structure of the ADNS:

- (f) The name as a whole (x.y.z) can be easily guessable, by being as close as possible to the real-world name;
- (g) The name as a whole (x.y.z) is acceptable to the native Arab ear, i.e. user friendly.

The last two criteria are of utmost importance in the deployment of ADNS and its success.

### A. LINGUISTIC ISSUES

There are a number of linguistic issues that have been proposed with respect to the usage of the Arabic language in domain names. This section will highlight some of them. This section is extracted from the paper of Dr. Al-Zoman [7], for details the reader is encouraged review the said reference.

#### 1. *Tashkeel (Diacritics)*

With respect to domain names, al-tashkeel can be supported only in the user interface but should not be stored in the zone file. Therefore, it can be striped off at the preparation of internationalized strings (“stringprep”) phase.

## 2. Kasheeda (Tatweel)

With respect to domain names, Kasheeda should not be used in Arabic domain names.

## 3. Character folding

“A character folding is the process where multiple letters (that may have some similarity with respect to their shapes) are folded into one shape. This includes:

- Folding Teh Marbuta and Heh at the end of a word;
- Folding different forms of Hamzah;
- Folding Alif Maksura and Yeh at the end of a word;
- Folding Waw with Hamzah and Waw.

With respect to Arabic language, character folding is unacceptable because it changes the meaning of the words and it is against the simplest spelling rules. Replacing a character with another character, which may have the same shape but different pronunciation, will give a different meaning. This will lead to have only one form (word) out many other forms of words that are made by all the combination of folded characters. Hence, the other forms will be masked by the common form.” [7]

“It is often that because of laziness or weakness in spelling, handwriting mixes between different characters (e.g., Heh and Teh-Marbuta). However, this is not the case in published and printed materials. One of the motivations to support the Arabic language in domain names is to preserve the language particularly with the spread of the globalization movement. Hence, character folding is working against this motivation since it is going to have a negative affect on the principle and ethics of the language. Therefore, we should let the technology works for the language and not the other way. Character folding should not be allowed.”[7]

## B. SUPPORTED CHARACTER SET

It is recommended to use only the following Unicode characters. These are based on the study and the report from the Arabic linguistic committee of AINC based on Unicode version 3.1

TABLE 1. CHARACTERS FROM UNICODE ARABIC TABLE (0600--06FF)

Unicode	Character	Character Name
0621	(ﺀ)	ARABIC LETTER HAMZA
0622	(ﺀِ)	ARABIC LETTER ALEF WITH MADDA ABOVE
0623	(ﺀٍ)	ARABIC LETTER ALEF WITH HAMZA ABOVE
0624	(ﺀَ)	ARABIC LETTER WAW WITH HAMZA ABOVE
0625	(ﺀِ)	ARABIC LETTER ALEF WITH HAMZA BELOW
0626	(ﺀِءِ)	ARABIC LETTER YEH WITH HAMZA ABOVE
0627	(ﺀ)	ARABIC LETTER ALEF
0628	(ﺐ)	ARABIC LETTER BEH
0629	(ﺖ)	ARABIC LETTER TEH MARBUTA
062A	(ﺕ)	ARABIC LETTER TEH
062B	(ﺚ)	ARABIC LETTER THEH
062C	(ﺝ)	ARABIC LETTER JEEM
062D	(ﺡ)	ARABIC LETTER HAH
062E	(ﺦ)	ARABIC LETTER KHAH
062F	(ﺩ)	ARABIC LETTER DAL

0630	(ذ)	ARABIC LETTER THAL
0631	(ر)	ARABIC LETTER REH
0632	(ز)	ARABIC LETTER ZAIN
0633	(س)	ARABIC LETTER SEEN
0634	(ش)	ARABIC LETTER SHEEN
0635	(ص)	ARABIC LETTER SAD
0636	(ض)	ARABIC LETTER DAD
0637	(ط)	ARABIC LETTER TAH
0638	(ظ)	ARABIC LETTER ZAH
0639	(ع)	ARABIC LETTER AIN
063A	(غ)	ARABIC LETTER GHAIN
0641	(ف)	ARABIC LETTER FEH
0642	(ق)	ARABIC LETTER QAF
0643	(ك)	ARABIC LETTER KAF
0644	(ل)	ARABIC LETTER LAM
0645	(م)	ARABIC LETTER MEEM
0646	(ن)	ARABIC LETTER NOON
0647	(هـ)	ARABIC LETTER HEH
0648	(و)	ARABIC LETTER WAW
0649	(ى)	ARABIC LETTER ALEF MAKSURA
064A	(ي)	ARABIC LETTER YEH

0660	(٠)	ARABIC-INDIC DIGIT ZERO
0661	(١)	ARABIC-INDIC DIGIT ONE
0662	(٢)	ARABIC-INDIC DIGIT TWO
0663	(٣)	ARABIC-INDIC DIGIT THREE
0664	(٤)	ARABIC-INDIC DIGIT FOUR
0665	(٥)	ARABIC-INDIC DIGIT FIVE
0666	(٦)	ARABIC-INDIC DIGIT SIX
0667	(٧)	ARABIC-INDIC DIGIT SEVEN
0668	(٨)	ARABIC-INDIC DIGIT EIGHT
0669	(٩)	ARABIC-INDIC DIGIT NINE

Source: A. Al-Zoman, "Supporting the Arabic Language in Domain Names", October 2003

TABLE 2. CHARACTERS FROM UNICODE BASIC LATIN TABLE (0000—007F):

Unicode	Digit	Digit Name
0030	(0)	DIGIT ZERO
0031	(1)	DIGIT ONE
0032	(2)	DIGIT TWO
0033	(3)	DIGIT THREE
0034	(4)	DIGIT FOUR
0035	(5)	DIGIT FIVE
0036	(6)	DIGIT SIX
0037	(7)	DIGIT SEVEN
0038	(8)	DIGIT EIGHT
0039	(9)	DIGIT NINE
002D	(-)	HYPHEN-MINUS
002E	(.)	FULL STOP (Dot)

Source: A. Al-Zoman, "Supporting the Arabic Language in Domain Names", October 2003

### C. ARABIC DOMAIN NAME STRUCTURE

A domain name consists of multiple words (codes) that are separated by dots. Based on research and rationale, and reference to [7], after considering and weighing a multitude of alternatives and combinations; and after eliminating of many possible combinations, the following structure is the proposed structure for Arabic domain name based on the conclusion that the geographical classification is adopted and there is no activity classification anymore corresponding to (.com), (.org) ... etc.

The proposed structure has the following syntax(to be read from right to left)

**<A-TLD>.<entity-name>**

Where, <entity-name> represents the Arabic name of the entity, and <A-TLD> represents an Arabic TLD. For example,

شركة-الزومان.سعودية  
شركة-أرامكو.سعودية  
المركز-التجاري.سورية  
اتحاد-كرة-الطائرة.عربي  
جامعة-الخرطوم.سودان

One of the features of this syntax is switching the order of reading and writing the category identifier to be in the beginning and to be part of the name. The rationale behind the sequence is that in the Arabic language, it is more proper to switch the order so company.com becomes com.company, which is technically feasible.

### D. RECOMMENDED ARABIC TLDS AND CCTLDS

Based on [7], precisely, the current suggested Arabic gTLDs which use the entity type for the classification are not suitable for the Arabic language. Therefore, with respect to Arabic gTLDs, it is suggested to use the geographical classification, using geographical descriptive words such as "دولي" and "عربي".<sup>2</sup>

With respect to Arabic ccTLDs, it is recommended to use a full word either the nationalities or the short country names without (ال).

<sup>2</sup> In later phase (if needed) other Arabic gTLDs can be added which represents activities such as "معلوماتي", "تجاري", "تعليمي".

## E. ARABIC LINGUISTIC ISSUES AFFECTED BY TECHNICAL CONSTRAINTS

In this section the technical aspect of some linguistic issues as well as TLD mapping is discussed

### 1. Numerals

According to Dr. Al-Zoman [7], in the Arab world, there are two sets of numerical digits used

- Set I: (0, 1, 2, 3, 4, 5, 6, 7, 8, 9),  
Mostly used in the western part of the Arab world (al-maghrib al-arabi).
- Set II: (٠, ١, ٢, ٣, ٤, ٥, ٦, ٧, ٨, ٩),  
Mostly used in the eastern part of the Arab world (al-mashriq al-arabi).

The zero can easily get confused with the dot, there have been some suggestions to use Set I because it is though that there is similarity (or confusion) between the Arabic zero (0) and the dot (.). But the differences appear clearly in publications. The zero is larger and is printed higher than the dot. Also, With respect to a domain name, it is quite easy to distinguish between the zero and the dot based on the context of the domain name. And since the two sets are used they should be both supported.

The recommendation is that both sets should be supported in the user interface and both are folded to one set (Set I) at the preparation of internationalized strings (e.g., "stringprep") phase.

### 2. Space

Space is strictly not allowed in domain names, as it is a control character thus the hyphen is proposed as a separator between Arabic words as confusion can take place if the words are typed without a separator unlike ASCII.

### 3. TLD mapping

In the Arabic language there are two choices for the definition of the ccTLD terms [9].

One is the full word; the other is the postal code abbreviation. There has been a lot of discussions about the right choice especially when the short code can at times have funny meanings in the Arabic language. It is proposed to do TLD mapping as the right choice for Arabic language in this case people can type the short code while the full length word is used in advertising and in branding.

Technically that should not be a problem and can be easily implemented at the root server level. The same can apply for gTLDs where you map the full length and a short version of the gTLD to facilitate typing.

In the table below are the ccTLD codes for the Arab countries in the full word form and the postal Code form , the two representations are to be Mapped as recommended so “إمارات” used for printing and the short form “.ام.” used for typing.

TABLE 3. PROPOSED ARABIC CCTLDS

Country Official Names	Country Code		Short Name without (ال)
	English	Arabic	
Hashemite Kingdom of Jordan	Jo	ار	أردن
United Arab Emirates	Ae	ام	إمارات
Kingdom of Bahrain	Bh	بح	بحرين
Republic of Tunisia	tn	تو	تونس
People's Democratic Republic of Algeria	Dz	جز	جزائر
Federal and Islamic Republic of Comoros	Km	قم	جزر القمر
Republic of Djibouti	dj	جي	جيبوتي
Kingdom of Saudi Arabia	sa	سع	سعودية
Democratic Republic of Sudan	sd	سد	سودان
Syria Arab Republic	sy	سر	سورية
Somalia Democratic Republic	so	صو	صومال
Republic of Iraq	iq	عر	عراق
Sultanate of Oman	om	عم	عمان
Palestine	ps	فل	فلسطين
State of Qatar	qa	قط	قطر
Stat of Kuwait	kw	كو	كويت
Lebanese Republic	lb	لب	لبنان
Socialist People's Libyan Arab Jamahiriya	ly	لي	ليبيا
Arab Republic of Egypt	eg	مص	مصر
Kingdom of Morocco	ma	مع	مغرب
Islamic Republic of Mauritania	mr	مو	موريتانيا
Yemen Arab Republic	ye	يم	يمن

Source: A. Al-Zoman, "Supporting the Arabic Language in Domain Names", October 2003



### III. THE SOLUTION CONCEPT

#### A. DNS-BASED SOLUTION

Historically, there have been different approaches to the Arabic Domain Names problem. Solutions fell under one of two categories, namely DNS solutions and Keyword solutions. "Keywords" are not domain names. Rather, they exist as an additional layer above the DNS. Therefore, whilst DNS-based solutions only require the use of the Internet's DNS resolution infrastructure, keyword-based solutions also require a "URL Forwarding" technique to map simple references/names/phrases to domain names or IP addresses.

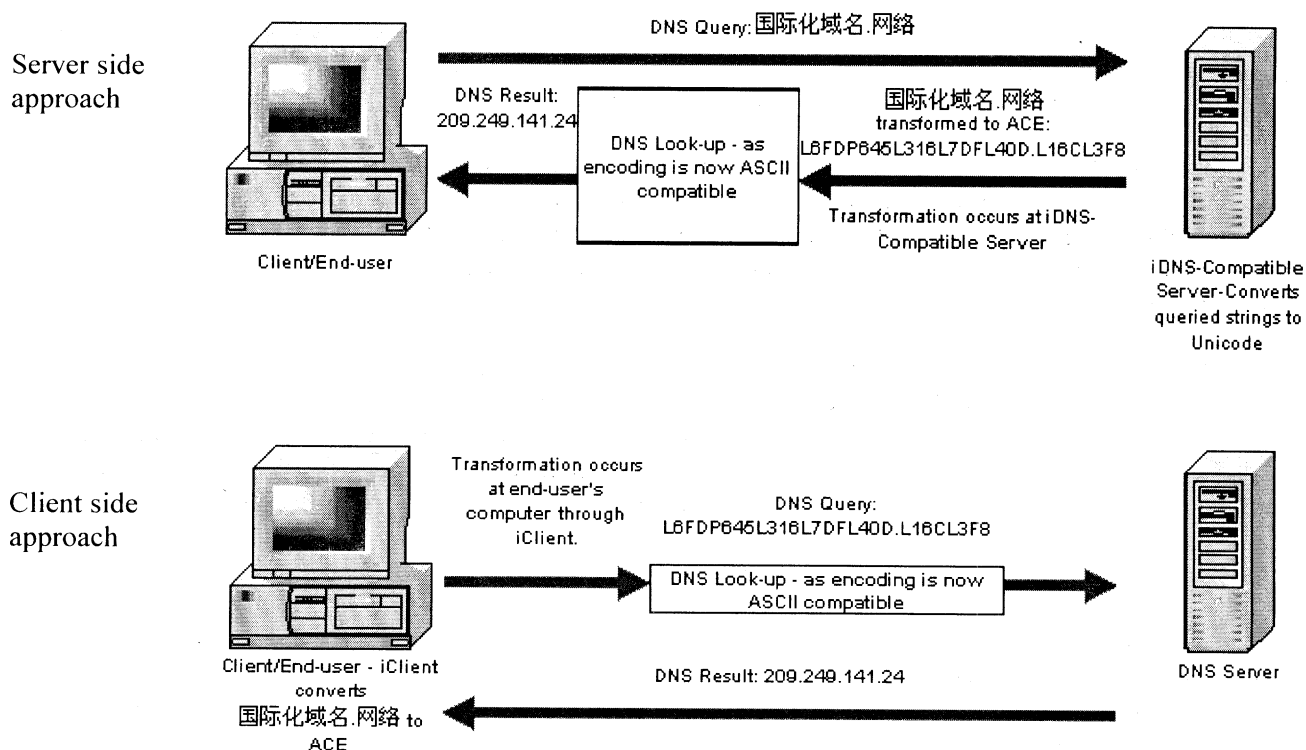
As a pre-requisite to using "keywords", each resolvable domain name is registered in a keyword-based directory in addition to the DNS registry. The keyword directory is searched during the "look up" process, and matches in the keyword registry are used to locate a particular URL or a list of matching sites under that particular keyword. On the other side, DNS-based solutions are IETF compliant, they do preserve the language integrity and they also allow hyperlinks.

Thus, for Arabic Domain Names, it is recommended to employ a DNS-based solution to preserve the integrity of the Arabic language, to eliminate any confusion and to become fully interoperable with existing DNS schemes [ 1,2,3 ].

#### B. CLIENT-SIDE APPROACH

Generally, there are two schemes for resolving of multilingual domain names as depicted in Figure (3).

**Figure 3. Different approaches for resolution of Multilingual Domain Names**



The proposed architecture for ADNS is in accordance with the IETF standard for Internationalized Domain Names (IDN) [4,5,6] which recommends a client side resolution scheme vs. a server side solution to accommodate non-Latin languages like Arabic. This is a layer above the current Internet structure.

## IV. OPERATIONAL ASPECTS

### A. REGISTRAR-RELATED ASPECTS

Currently most of the registries employ either of the two public available registration protocols, RRP (registrar-registry-protocol) and EPP (extensive provisioning protocol). So registry runs a server program, which employs either one of the two protocols.

Registrar(s) develop own client application to gather information from end-user and pass information to registry through the registration protocol. RFC documents on RRP and EPP are available on IETF web sites.

There are two most popular Registry/Registrar Scheme, thick and thin. For thick registry, the registry database stores the detailed information, such as detailed information on registrant (name, email, phone, fax and etc). So on registrar side, it just needs to store minimal information. For thin registries, the registry database will not store every detail.

A single appointed company, that is to be appointed by an authority representing the different stakeholders, would run the unique registry.

A good commercial model would be to follow the ICANN model where there are accredited registrars that can appoint resellers at a premium. That way the strong technically qualified companies would act as registrars and a wide reseller network can be established.

### B. THE NETWORK STRUCTURE AND COMPONENTS

#### 1. *Hierarchy and Structure of root servers*

There are 13 root server located globally for the “.” root zone. Then under the global root zone, there are gTLDs such as “.com”, “.net” and etc as well as ccTLDs such as “.ae”, “.cn” and “.sg”. These zones are hosted by either private corporate like VeriSign, or government agencies like CNNIC.

Then under those gTLDs and ccTLDs are public held domain names registered to those registries. The global “.” root servers contain information only on gTLDs and ccTLDs. The servers used to host gTLDs and ccTLDs contain information on how to resolve the names registered under corresponding TLD. If a query arrives that current server does not have any information locally, it will refer to upper level DNS servers for more information.

In the arena of Arabic Domain Names, it is proposed that a single body acts as the authority for the standardization of Arabic Domain names. This body should appoint either (a) a single company to run a unique registry of Arabic domain names or (b) multiple companies that can work together in coordination. On the country-specific level, CCTLDS will be managed independently in each country by the country appointed Network Administrator; a single appointed company would manage GTLDS.

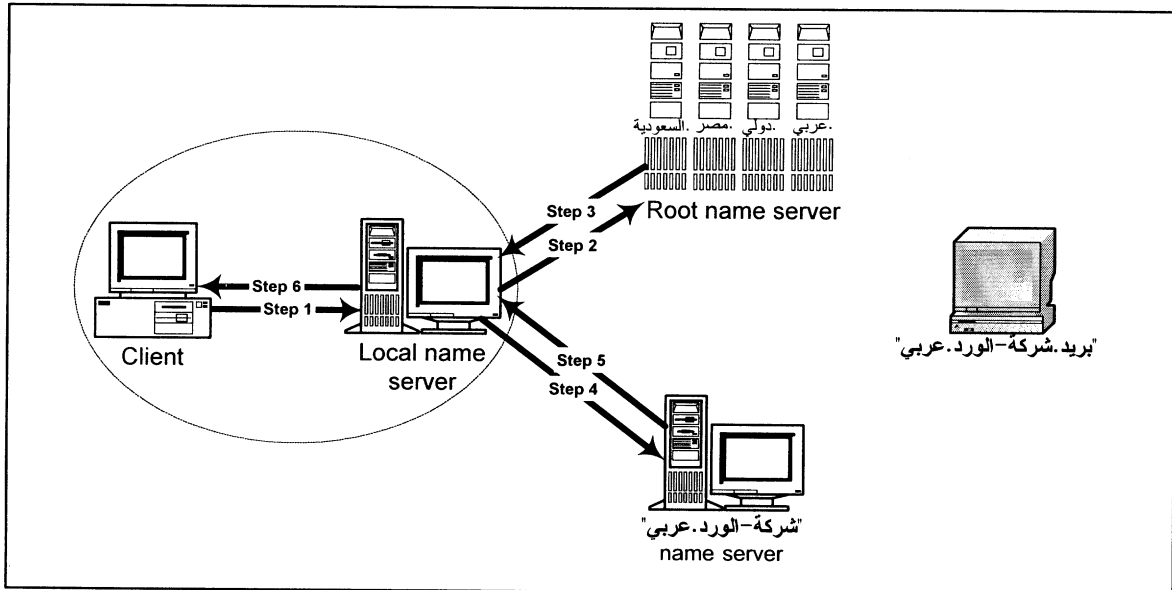
#### 2. *Resolution mechanism*

The proposed architecture for ADNS is based on a client side resolution scheme, which is a layer above the current Internet structure. On the client side, workstations will be running some DNS resolution agent service at system level. So when the local agent receives a DNS resolution request from upper-level applications, it will take over the duty to talk to DNS servers configured for the workstation. When the agent receives responses from DNS server, it will pass back the results to upper-level applications.

Regarding IDN resolution, a software client intercepts the resolution request before it reaches local resolution agent, and replaces the multilingual query with ASCII Compatible Encoding (ACE) formatted

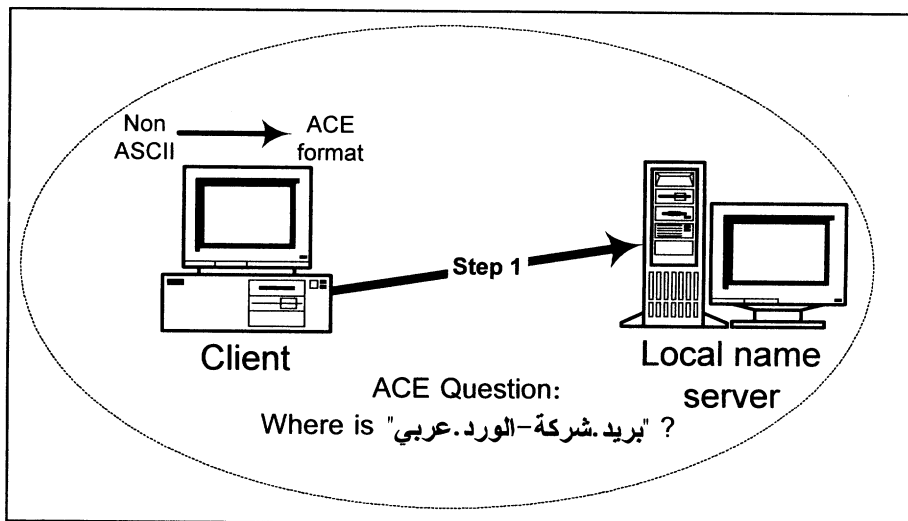
value, in this case PUNYCODE. So for local resolution agent, it just follows the normal DNS resolution process just as it does for ASCII formatted queries. Figure 4 depicts the resolution sequence of an Arabic Domain Name like **بريد.شركة-الورد.عربي**

**Figure 4. Root Servers, and domain resolution Diagram**

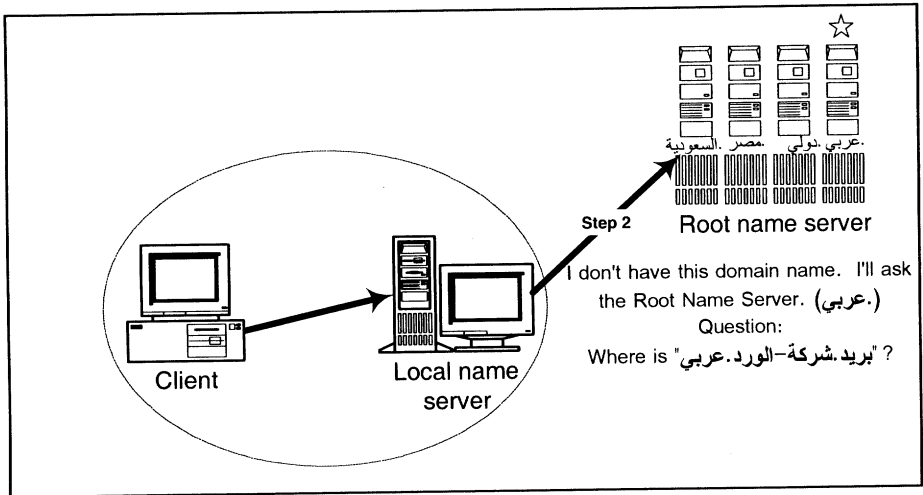


Steps of resolution:

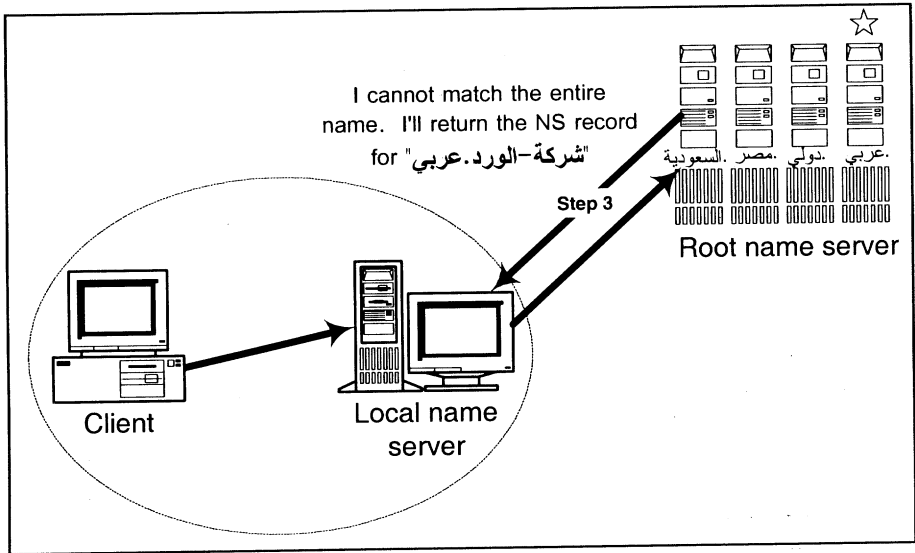
- Step 1: the client sends query containing the domain name to the local name server



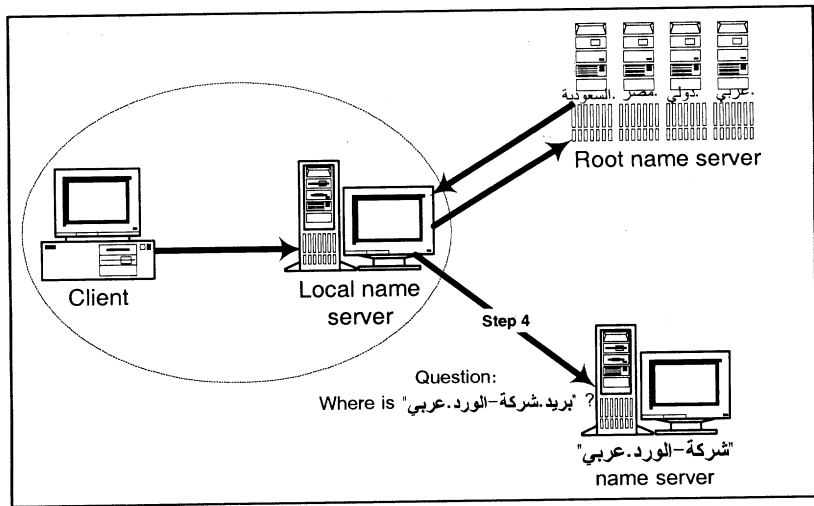
- Step 2: the local name server may not have the information about the domain name, so it sends the query to one of the root server



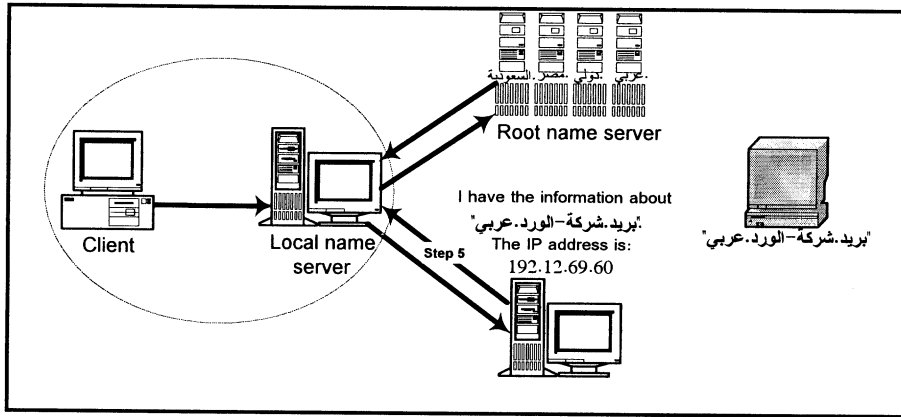
- Step3: the root server cannot match the entire name, returns best match – the NS (name resolution) record for شركة-الورد.عربي and it also returns all records which is related to this record



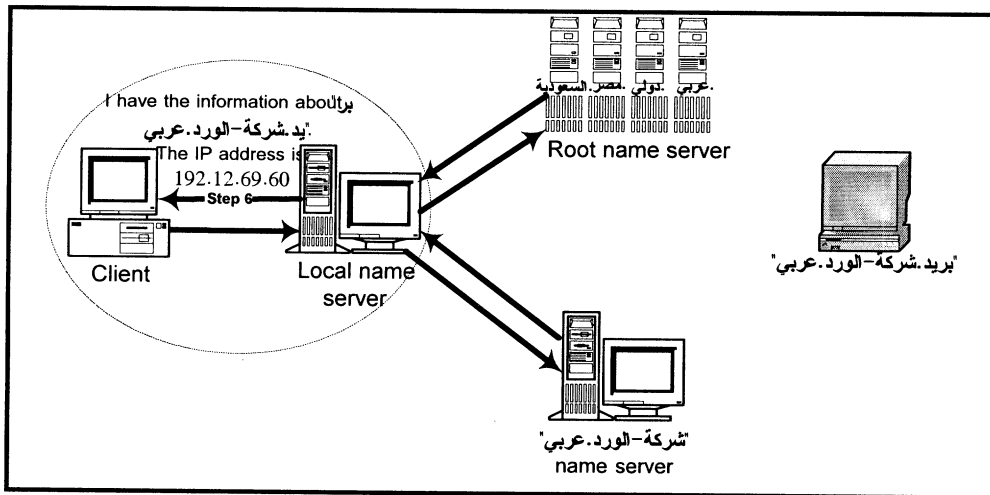
- Step 4: the client sends the same query to the name server authoritative for the mail Zone (ns1. بريد. شركة-الورد.عربي)



- Step 5: the server has a information about **بريد. شركة-الورد.عربي** and returns the answer: IP address = 192.12.69.60



- Step 6: armed with the IP address, the client can establish a TCP connection with the destination.



## V. CONCLUSION, RECOMMENDATIONS AND OPEN ISSUES

### A. CONCLUSION

The proposed RFC is in full coherence with the IETF IDN standard and takes into account some Arabic language specific issues just as recommended by ICANN and by Dr. Al-Zoman research work. This is to insure that an Arabic intranet is never created where access to Arabic Internet content is limited to some isolated portion of cyberspace.

As for the linguistic issues as summarized by Al-Zoman, it is a compromise between Grammatical rules of the Arabic language and the ease of use of the language on the internet thus making it more user-friendly in the Arabic Language. The decision of using TLD Mapping is the best solution to preserve the ease of typing and the clarity of meaning in the Arabic language.

The proposed ADNS system is fully compatible with the ICANN and IETF recommendations. It is a client side solution to transform the Arabic Unicode characters into an ASCII string that can operate in full compatibility with the existing Internet protocols and structure. This way, the creation of an Arabic intranet is avoided. The Arabic domain names will be transferred to a Punnycode at the client machine using a plugin then the client would communicate with the local name server with ASCII string as is the current case.

It is proposed in this document to follow the IETF technical standards for IDN so as not to create an Arabic Intranet. It is also proposed to go for TLD mapping for ccTLDs and gTLDs, to switch the order of how an Arabic domain name is typed to better suit Arabic grammatical rules. It is also recommended to use the hyphen as a word separator and to use both Arabic numbers and Indian numbers to solve the zero and dot confusion problem.

### B. RECOMMENDATION

It is time for the Arabic language to be widely disseminated on the Internet. With the number of Arabic internet users in excess of 5 million and increasing exponentially, it is estimated that the quick implementation of the recommendations of this RFC, will open a market in excess of 500,000 domain names making this estimate based on the fact that the number of domains sold in the western world is 10% of the number of internet Users. Domain names and email addresses are key to the start of the Arabic Internet industry with all the industries that will emerge like web hosting, search engines and e-commerce.

It is recommended that all stakeholders that have historically been linked with the Arabic Domain Name efforts from 2000 to-date, including chronologically non-profit organizations like the Multilingual Internet Names Consortium (MINC), Arab League, ITU, UN Information and Communication Technology (ICT) Task Force and UN ESCWA, as well as still active Arabic domain name companies, to coordinate their efforts and collectively form a standardization authority that is mutually recognized by all stakeholders.

This group to be formed should act as a Standardization Authority, which will be entitled to appoint either a single company, or set sufficient policy guidelines for multiple companies to operate an Arabic-wide registry in approved Arabic gTLDs, for instance (عربي.) the company/companies should be selected on the basis of agreed upon criteria. As for ccTLDs each country will run its own ccTLD in Arabic along with the ASCII ccTLD.

### C. OPEN ISSUES

The issue of Trademarks and registration policies should also be decided by the Standardization Authority along with legal experts, as well as determination of a list of forbidden domain names be it political or religious or government names such as (مصر) (السعودية) (الله) (النبي) (المسيح) (الرسول) (لفظ الجلالة) and so on.

Migration issues still need to be considered; as per the linguistic recommendations, it is recommended to remove the equivalent of “.com” TLD all together and stick to “.عربي” and “.دولي”; however, in order not to disrupt the service to the current end-users who have been using the “.shareka” and/or “.sheen” for a number of years, such a replacement proposal must only be carried out after a thoughtful and coordinated linguistic and technical strategy for seamless migration has been agreed upon by all stakeholders. Such a strategy could in principle include elements of TLD mapping, which was previously described.

## References

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## DNS TECHNOLOGY<sup>3</sup>

### Domain Naming and Registration with DNS

Though IP addresses allow computers and routers to identify each other efficiently, humans prefer to work with names rather than numbers. The **Domain Name System - DNS** - supports the best of both worlds.

DNS allows nodes on the public Internet to be assigned both an IP address and a corresponding name, called a **domain name**. For DNS to work as designed, these names must be unique worldwide. Hence an entire "cottage industry" has emerged around the purchasing of domain names in the Internet name space.

### DNS Name Space

DNS is a **hierarchical** system. DNS organizes all registered names in a tree structure.

At the base or **root** of the tree are a group of **top-level domains** including familiar names like com, org, and edu and numerous **country-level domains** like fi (Finland), ca (Canada), and my (Malaysia). One generally cannot purchase names at this level. However, in a well-publicized and controversial event in 2000, the island nation of Tuvalu agreed to receive a large payment in return for rights to the root domain tv.

Below this level are the second-level **registered domains** such as about.com. These are domains that organizations can purchase from any of numerous accredited **registrars**. For nodes in the com, org, and edu domains, the Internet Corporation for Assigned Names and Numbers (ICANN) oversees registrations.

Below that, **local domains** like compnetworking.about.com are defined and administered by the overall domain owner. DNS supports additional tree levels as well. The period ('.') always separates each level of the hierarchy in DNS.

### DNS Root Level and Other Servers

DNS is also a **distributed** system. The DNS database contains a list of registered domain names. It further contains a mapping or conversion between each name and one or more IP addresses. However, DNS requires a coordinated effort among many computers (servers); no one computer holds the entire DNS database. Each **DNS server** maintains just one piece of the overall hierarchy - one level of the tree and then only a subset or **zone** within that level.

The top level of the DNS hierarchy, also called the **root** level, is maintained by a set of 13 servers called **root name servers**. These servers have gained some notoriety for their unique role on the Internet. Maintained by various independent agencies, the servers are uniquely named A, B, C and so on up to M. Ten of these servers reside in the United States, one in Japan, one in London, and one in Stockholm, Sweden.

### DNS Resolvers

DNS works in a client/server fashion. DNS servers respond to requests from DNS clients called **resolvers**. ISPs and other organizations set up local DNS resolvers as well as servers. Most DNS servers also act as resolvers, routing requests up the tree to higher-level DNS servers, and also delegating requests to other servers. DNS servers eventually return the requested mapping (either address-to-name or name-to-address) to the resolver.

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<sup>3</sup> Source: [www.verisign.com](http://www.verisign.com)

## DNS and DHCP

DNS was not designed to work with dynamic addressing such as that supported by DHCP. DNS requires that fixed (**static**) addresses be maintained in the database. Web servers in particular require fixed IP addresses for this reason.

## IP Network Partitioning

Computer networks consist of individual segments of network cable. The electrical properties of cabling limit the useful size of any given segment such that even a modestly-sized local-area network (LAN) will require several of them. Gateway devices like routers and bridges connect these segments together although not in a perfectly seamless way.

Besides partitioning through the use of cable, subdividing of the network can also be done at a higher level. **Subnets** support virtual network segments that partition traffic flowing through the cable rather than the cables themselves. The subnet configuration often matches the segment layout one-to-one, but subnets can also subdivide a given network segment.

## IP Network Numbering

Even without subnetting (explained later), hosts on the Internet or any other IP network are assigned a **network number**. Network numbering allows a group of hosts (peers) to communicate efficiently with each other. Hosts on the same network may be computers located in the same facility or all computers used by a workgroup, for example. **Multi-homed** hosts, that contain multiple network adapters, can belong to multiple networks, but each adapter is assigned exactly one network number.

Network numbers look very much like IP addresses, but the two should not be confused. Consider for example the host IP address 10.0.0.1, an address commonly used on private networks. Because it is a Class A address, with no subnetting employed, its leftmost byte (eight bits) by default refer to the network address and all other bits remain set at zero. Thus, 10.0.0.0 is the network number corresponding to IP address 10.0.0.1.

The portion of the IP address that does not refer to the network refers instead to the **host address** - literally, the unique identifier of the host on that network. In the above example, the host address becomes '0.0.0.1' or simply '1'. Also note that a network address becomes a reserved address that should not be assigned to any actual host. Configuring a live host at 10.0.0.0 in the example above could impact communications for all hosts on that network.

The table below illustrates the default numbering scheme for Class A, B, and C networks.

Class	Host address range	Network address	Default mask
A	0.0.0.0 - 127.255.255.255	x.0.0.0	255.0.0.0
B	128.0.0.0 - 191.255.255.255	x.x.0.0	255.255.0.0
C	192.0.0.0 - 223.255.255.255	x.x.x.0	255.255.255.0

In general, a network address uses the leftmost byte of its hosts' addressing if the hosts fall within the Class A range, the leftmost two bytes for hosts in Class B, and the leftmost three bytes for hosts in Class C. This algorithm is applied in practice through the use of a **network mask**. The above table shows the decimal representation of the default network masks that is commonly used by network operating systems. Note that the decimal value '255' corresponds to one byte that has all bits set to one (11111111).

## **Benefit of Network Addressing**

Network addressing fundamentally organizes hosts into groups. This can improve security (by isolating critical nodes) and can reduce network traffic (by preventing transmissions between nodes that do not need to communicate with each other). Overall, network addressing becomes even more powerful when introducing subnetting and/or supernetting.

## Annex II

### **MULTILINGUAL DNS TECHNOLOGY STRUCTURE <sup>4</sup>**

#### **The Domain Name System Today**

Currently, the Domain Name System (DNS) only recognizes domain names consisting of a combination of ASCII characters, including A - Z, 0 - 9 and the hyphen "-". These letter, number, and dash characters are based on the English writing system.

#### **The Movement Towards Internationalized Domain Names (IDN)**

The Internet has grown from its roots as a small research network into a global electronic commerce medium. With an early US-centric focus, most common Internet applications have used the ASCII character set to represent text in English. There are now Internet users all over the world whose native language is represented in character sets other than ASCII. These non-ASCII characters sets are not supported in the global DNS. The DNS does not adequately address the large population of non-English speaking Internet users.

To better serve this large and growing audience, the global Internet community must expand the current DNS to support more than just English characters. Specifically, the desire is to internationalize names used on the Web in Uniform Resource Locators (URLs), more commonly referred to as Web site addresses.

This expansion would include not only names that are very close to English, such as the German word "straße," but also some very different from English, such as the Japanese representation for "light" 光

#### **Solving a Complex Problem**

Re-tooling the current DNS to recognize non-English characters requires a system that can:

- Interpret differences in written forms of communication
- Adapt to how computer systems support local written languages
- Overcome technological barriers for supporting those languages

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<sup>4</sup> Source: [www.i-dns.net](http://www.i-dns.net)

## Annex III

### **IDN STANDARDS<sup>5</sup>**

#### **IDN Standards Update**

- IDN-related Requests for Comment (RFCs) published.

The Domain Name System (DNS) only recognizes ASCII characters A-Z, 0-9 and '-'. This limits the number of characters that can be utilized to build domain names to 37 of the more than 40,000 characters identified within Unicode. To create domain names from the wider range of Unicode characters, a character-encoding scheme that uniquely maps Unicode code points to an ASCII representation must be used and standardized.

The Internet Engineering Task Force (IETF) has led the effort in standardizing the way that non-ASCII characters are to be represented within and handled by DNS. The IETF published three standards related to Internationalized Domain Names (IDN):

- Encoding scheme for IDNs
- Name preparation
- IDNs in applications

#### **Encoding Scheme**

The encoding scheme for IDNs will be an ASCII Compatible Encoding (ACE) that will encode the local language characters of an IDN into ASCII characters such that DNS can accurately answer a request for an address record. There are several types of ACE. In order to select an ACE as the standard, IETF must consider the difficult balance between compression and implementation. The preferred ACE will allow the greatest number of characters (code points) to be represented and will not be difficult to deploy. The VeriSign IDN Testbed leverages an ACE known as Row-based ASCII Compatible Encoding (RACE). At the time of the opening of the Testbed, RACE was a leading candidate to become the standard. Today, another ACE known as Punycode is the leading candidate. Now that the standard has been published, Testbed is migrating to that standard.

#### **Name Preparation**

The name preparation standard will provide the rules that will ensure uniqueness in registering Unicode code points. The rules outline the criteria through which a set of non-ASCII characters will be refined to ensure that there is no ambiguity within the registrations of a specific name space. These rules are Mapping, Normalization and Prohibition.

- **Mapping:** Characters may be mapped to nothing, a single character or multiple characters based upon their usefulness in text only or case. An example of usefulness: the soft hyphen (U+00AD) is discretionary and only has use within text and is invisible or ignored. The more common example is the mapping of a capital letter to a small letter such as 'B' (U+0042) to 'b' (U+0062). This is to ensure that a registration such as `ibm.com` does not have a conflict with other registration such as `IBM.com` or `iBm.com`.
- There are cases where a single character will map to multiple characters. The small letter sharp s or 'ß' (U+00DF) has an upper case representation of 'SS' (U+0053, U+0053). This is also the same upper case representation for 'ss' (U+0073, U+0073). Therefore, 'ß' maps to 'ss'

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<sup>5</sup> Source: [www.verisign.com](http://www.verisign.com)

- Normalization: Once a set of characters has been mapped, the set is normalized. Some input method editors (IME) enter characters that look exactly like another character, but have different code points. For example, 1 is a fullwidth digit one (U+FF11) and will normalize into a digit one (1) (U+0031). Normalization also ensures predictable results through ordering where characters have a number of combining diacritics.
- Prohibition: After normalization, the mapped and normalized set of characters is checked against a table of prohibited characters. These characters are prohibited for a variety of reasons but the most common are spaces that could lead to confusion and control characters that cannot be displayed.

## **IDNs in Applications**

The IDN in applications standard focuses on the location where the Unicode to ASCII mapping will take place. The IETF's approach makes the applications that send and receive traffic from DNS (browsers, e-mail clients, etc.) encode and un-encode the Unicode characters.

### **The Bottom Line**

All of these issues are currently outlined in the IETF Internet draft entitled *Preparation of Internationalized Host Names*. The VeriSign IDN Testbed is following this draft and will change as this draft is updated.

In summary, enhancing the current DNS to include more than just English characters is not a simple undertaking. There are quite a few open issues surrounding the deployment and use of IDNs that need to be resolved by the IETF.

### **Character variants**

The majority of domain name registrants register domain names that have meaning for them in their language - the domain name may be a name, word or phrase. These words or phrases have meaning in the registrant's language. Yet, the domain name may have different meanings in the context of other languages or cultures.

The domain name registration process was designed without consideration of language context. Technically speaking, the registrant registers a domain name using a set of characters within a script. Since scripts may be used by more than one language, the domain name is not registered in a specific language - it is registered in a specific script or combination of scripts. For example, the Latin script is used by many languages including English, French and German. A domain name registered using the Latin script could have meaning for several languages.

The overlap between scripts and languages define the variant issue. The Internationalized Domain Name (IDN) in Applications (IDNA) protocol enables the translation of all Unicode code points into unique ASCII strings. This broader range of characters has the potential to cause end-user confusion due to characters with similar appearances or interpretations, also known as variants. To reduce confusion and improve the end-user experience, it is necessary to address the variant issue.

While there are different types of variants, Character variants are not covered by the recently released IDN-related Requests for Comment (RFCs) as local scripts and languages drive them. Communities throughout the world, especially in Asia-Pacific, have asked Top-Level Domain (TLD) registries to address character variant issues in their domain spaces to ensure a positive end-user experience. implementing its Character Variant Solution helps improve the end-user experience.

## Annex IV

### **IETF AND ICANN RECOMMENDATIONS <sup>6</sup>**

IETF is a large open international community of network designers, operators, vendors, and researchers concerned with the evolution of the Internet architecture and the smooth operation of the Internet. It is open to any interested individual.

Actual technical work is done in Working Group organized by topics in several areas.

As mentioned above, a standard has come out of the IETF and recommended by ICANN.

Standards for ICANN Authorization of Internationalized Domain Name Registrations in Registries with Agreements <http://www.icann.org/riodejaneiro/idn-topic.htm#5>:

At the same time, the premise of this paper is that it would be a mistake for ICANN to pursue a burdensome and/or intrusive approach to IDN implementation – for example, by putting ICANN in the position of approving a character-equivalence table for each language, and of maintaining such tables. The deployment of IDNA within existing top-level domain registries is fundamentally a registry responsibility, and the registries will be in the best position to make appropriate implementation decisions themselves, and should have the freedom to make adjustments as experience dictates. Just as DNS registries embrace a wide diversity in registration policies and administrative procedures, reflecting the diversity of local Internet communities, it seems apparent that the vast diversity of human character sets and the languages from which they come compels a language-by-language, registry-led approach to the development of detailed registration policies and administrative procedures.

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<sup>6</sup> <http://www.icann.org/riodejaneiro/idn-topic.htm#5>

## **DIFFERENCES BETWEEN IDN AND KEYWORDS<sup>7</sup>**

IDN are Domain Names represented by native-language characters. Like regular ASCII domain names, IDN reside on the basic Domain Name System (DNS) infrastructure and every query here returns a definite and unique result.

"Keywords" are not domain names. Rather, they exist as an additional layer above the DNS. Therefore, whilst domain names only require the use of the Internet's DNS resolution infrastructure, keyword-based solutions also require a "URL Forwarding" technique to map simple references/names/phrases to domain names or IP addresses.

As a pre-requisite to using "keywords", each resolvable domain name is registered in a keyword-based directory in addition to the DNS registry. The keyword directory is searched during the "look up" process, and matches in the keyword registry are used to locate a particular URL or a list of matching sites under that particular keyword.

Whilst it may appear that they are similar, consumers need to note that both IDN and Keyword services operate on different levels. Only IDN provide the full user experience as required by market demands for IDN solutions that:

- are IETF-compliant
- retain the native language script after resolution (thereby facilitating brand awareness for native language web address on the URL bar)
- work across all established Internet protocols and commonly used applications (ie, email)
- support hyperlinks

As service offerings however, both IDN and "Keywords" provide useful and complementary dimensions to website accessibility.

### **How does the Internet Keywords system work?**

Here's the simple English explanation: The Internet Keywords system works much like the system (called DNS or Domain Name System) that fetches web sites when you type a URL (web address) or click a link or bookmark. The difference between the Internet Keywords system and the DNS system is that with the Internet Keywords system, you can use real words instead of URLs.

If you type [www.company.com](http://www.company.com), the browser sends that request to a DNS system, the DNS system routes the request to a computer (a server) at "company," and that server sends you a web page.

If you include a word or set of words such as cycling or southwest airlines (that is, you don't include [www.](http://www.com) or [.com](http://www.org) or [.org](http://www.org)), the browser sends those words to the Internet Keywords system at Netscape. The Internet Keywords system matches those words to a URL and quickly redirects your browser to that URL (starting the DNS process described above). If the Internet Keywords system can't match the words you typed, you get a search result on those words. If you type southwest airlines, your browser will fetch [www.iflyswa.com](http://www.iflyswa.com). Typing Apple iMac will take you to [www.apple.com/imac/](http://www.apple.com/imac/), and cnn will take you to [www.cnn.com](http://www.cnn.com). If you type a generic word, such as cycling or vacations, you'll go to a page that has a variety of links to resources about that subject, or your query will be sent to Net Search.

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<sup>7</sup> Source: [www.i-dns.net](http://www.i-dns.net)



Here is the technical explanation of how the Internet Keywords system works: Any single or multiword strings typed into the browser's Location field that don't include an extension such as .com, .net, .org, .de, or .jp, are sent via HTTP to a server at netscape.com. That keyword server pulls the string and compares it to several separate lists of keyword-URL pairs. If the keyword system finds a match, it redirects the user's browser to the URL of the keyword-URL pair. Failing a match against the lists, the user's browser is redirected to a Netscape Search page with the typed string as the search query.

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