المركز السعودي لمعلومات الشبكة
Saudi Network Information Center

هيئة الاتصالات وتقنية المعلومات
Communications and Information Technology Commission

SaudiNIC:

Supporting Arabic Domain Names

Raed Alfayez, SaudiNIC

ICANN60, Abu Dhabi, Oct 2017

Agenda

- About SaudiNIC
- Introduction
- SaudiNIC’s major efforts
- What is missing?

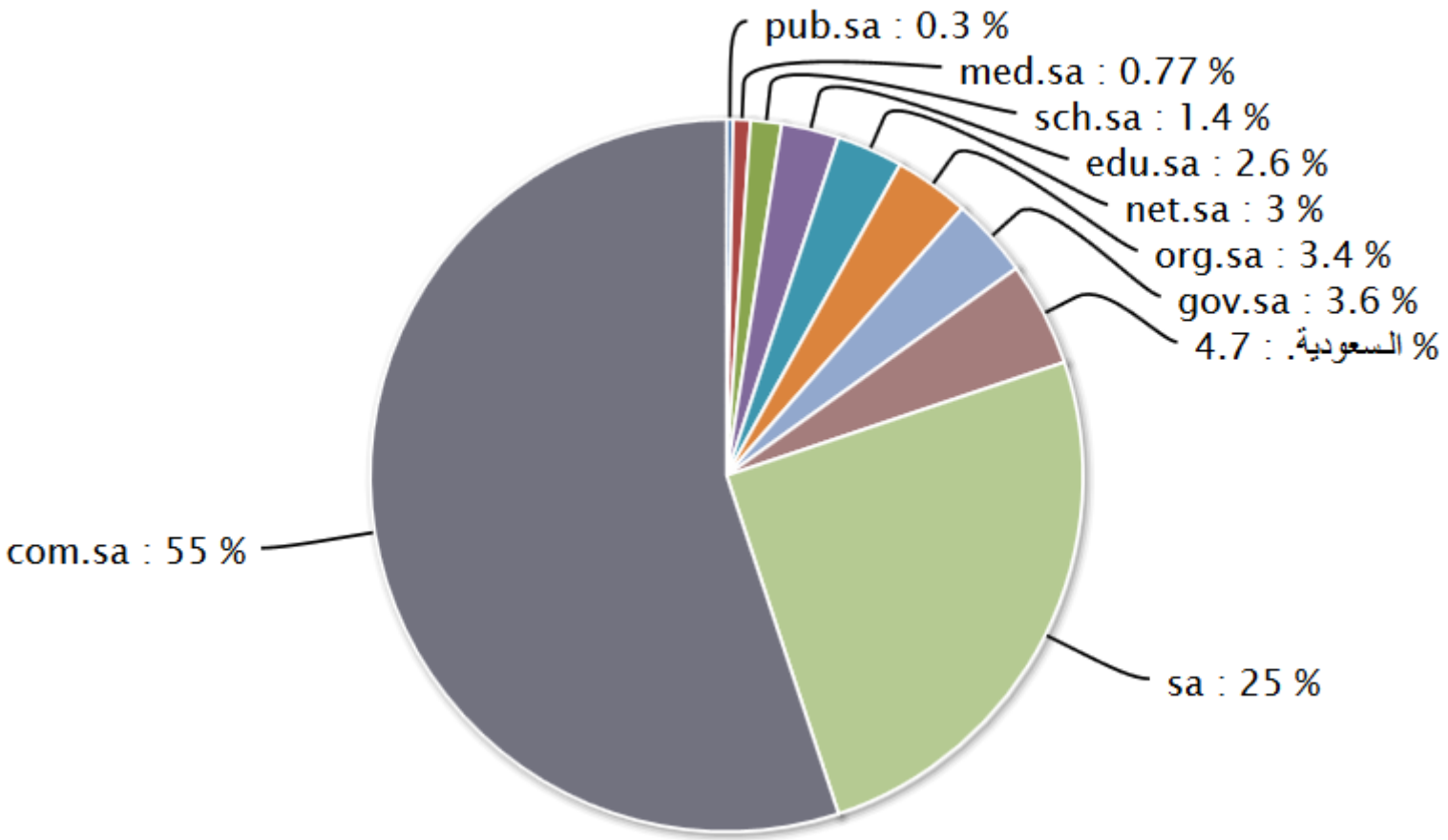
About SaudiNIC

- Administering the domain name space under:
  - (.sa) since 1995
  - (.السعودية) since 2010.
- Operated by a government organization:
  - CITC (Communication and Information Technology Commission)
- Coordinating with regional and international bodies in order to present the local community needs
- Leading the local and regional communities efforts towards supporting Arabic language in Domain Names since 2001 (more than 15 years of experience)

About SaudiNIC

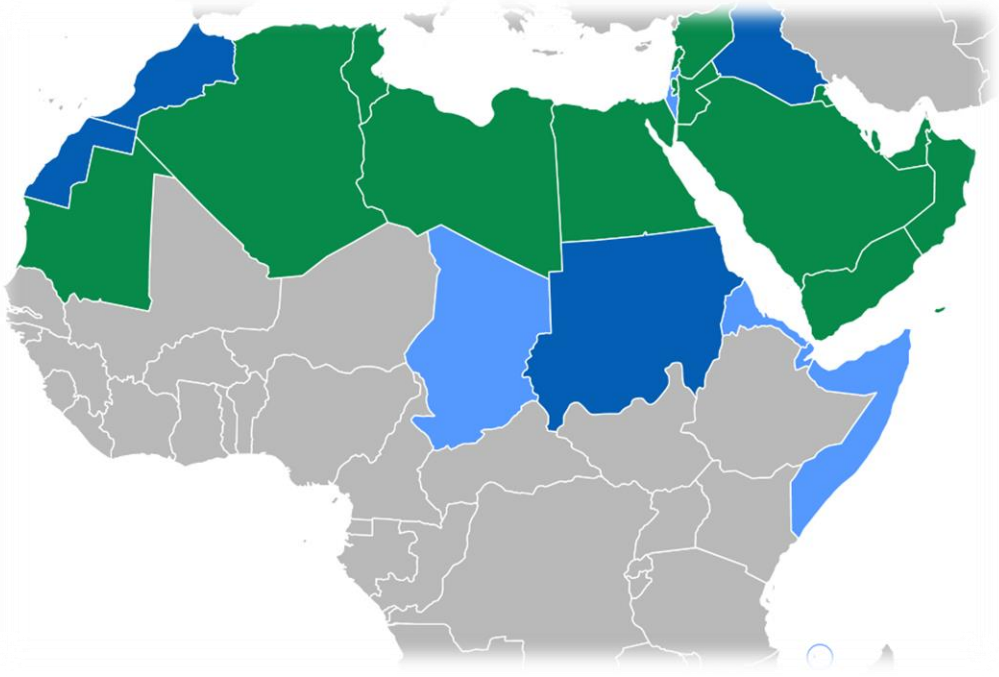
50,813 Domain names

2LD/3LD Domain Names Distribution %



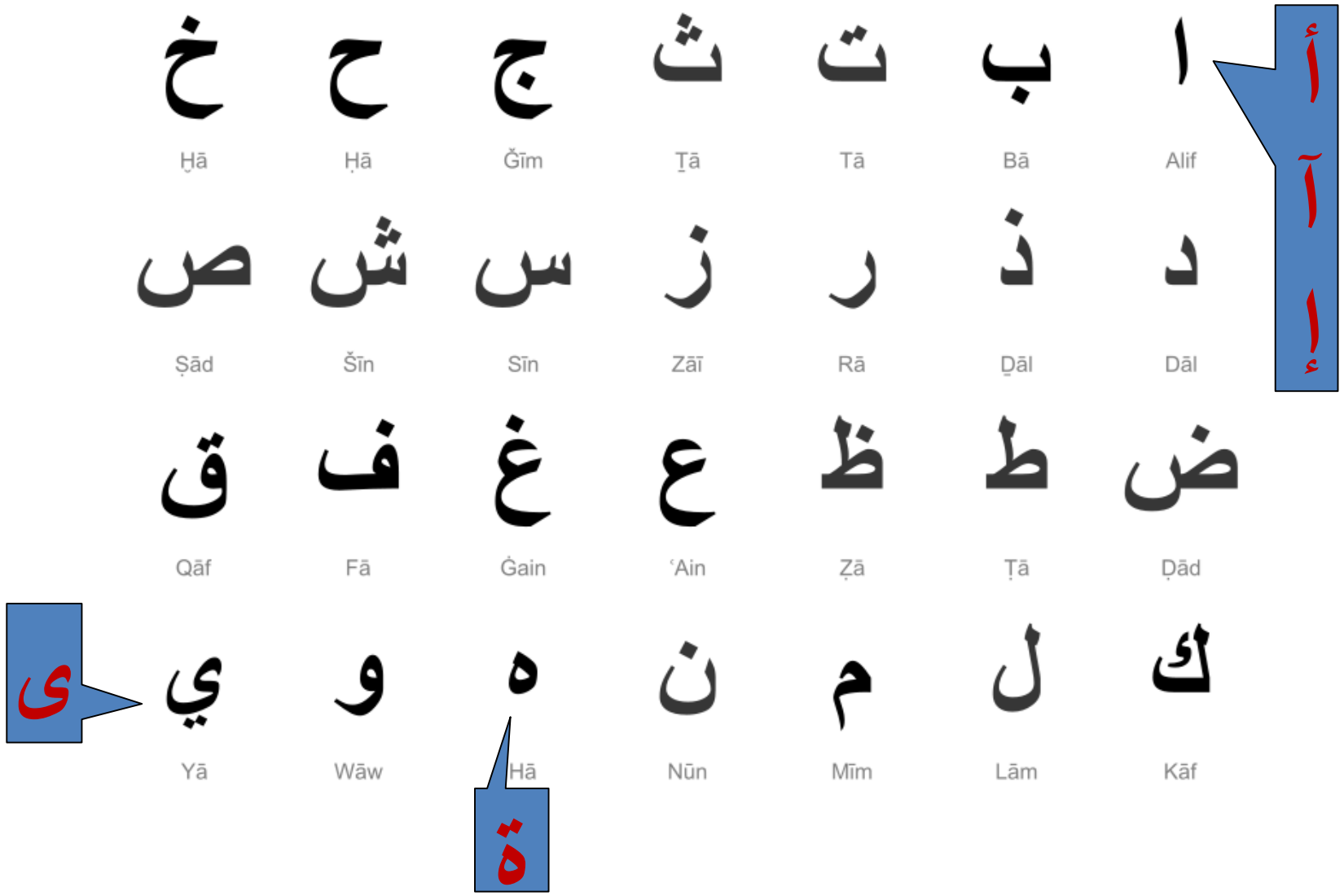
Introduction: Arabic Language

- Ranked as the 5nd language by native speakers in the world.
  - Native speakers: 295 million
- Considered as Official/Co-official language in 25 country

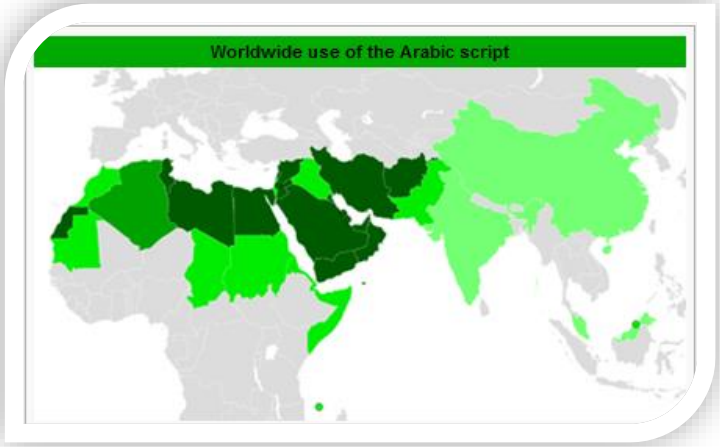


Source: http://en.wikipedia.org/wiki/Arabic_script

Introduction: Variants within the language



Introduction: Arabic Script



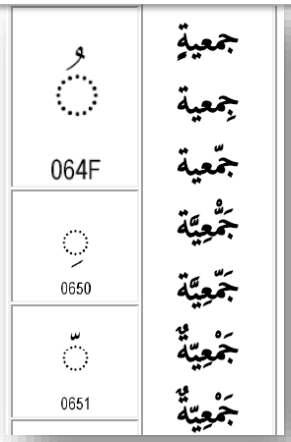
- The 2nd most widely used alphabetic writing system in the world
- Used by many languages such as:
  - Arabic, Urdu, Persian, Turkish, Kurdish, Pashto, …etc
- It is widely used by more than 43 countries
  - more than one billion potential users could be concerned in using Arabic script domain names.

Source: http://en.wikipedia.org/wiki/Arabic_script

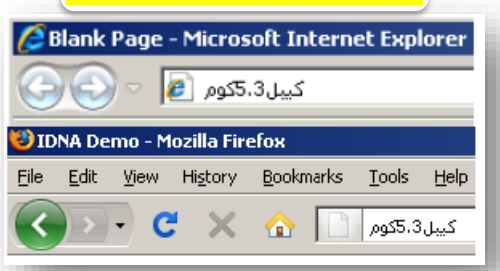
Arabic Script IDNs Major Issues

1. Combining Marks
2. Diacritics
3. World/label separators (space, ZWNJ, ZWJ, hyphen)
4. Digits
5. Confusing similar characters (e.g. variant tables)
6. Bidirectional

Non-spacing Marks



bidirectional



ZWNJ/ZWJ

Examples not using ZWNJ	Examples not using ZWNJ
طبل	طبل
input[0] = U+0637 input[1] = U+0628 input[2] = U+0644	input[0] = U+0637 input[1] = U+200c input[2] = U+0628 input[3] = U+0644

Digit

1.European digits	U+0030 .. U+0039	(0123456789)
2.Arabic-Indic digits	U+0660 .. U0669	(٠١٢٣٤٥٦٧٨٩)
3.Eastern Arabic-Indic digits	U+06F0 .. U+06F9	(۰۱۲۳۴۵۶۷۸۹)

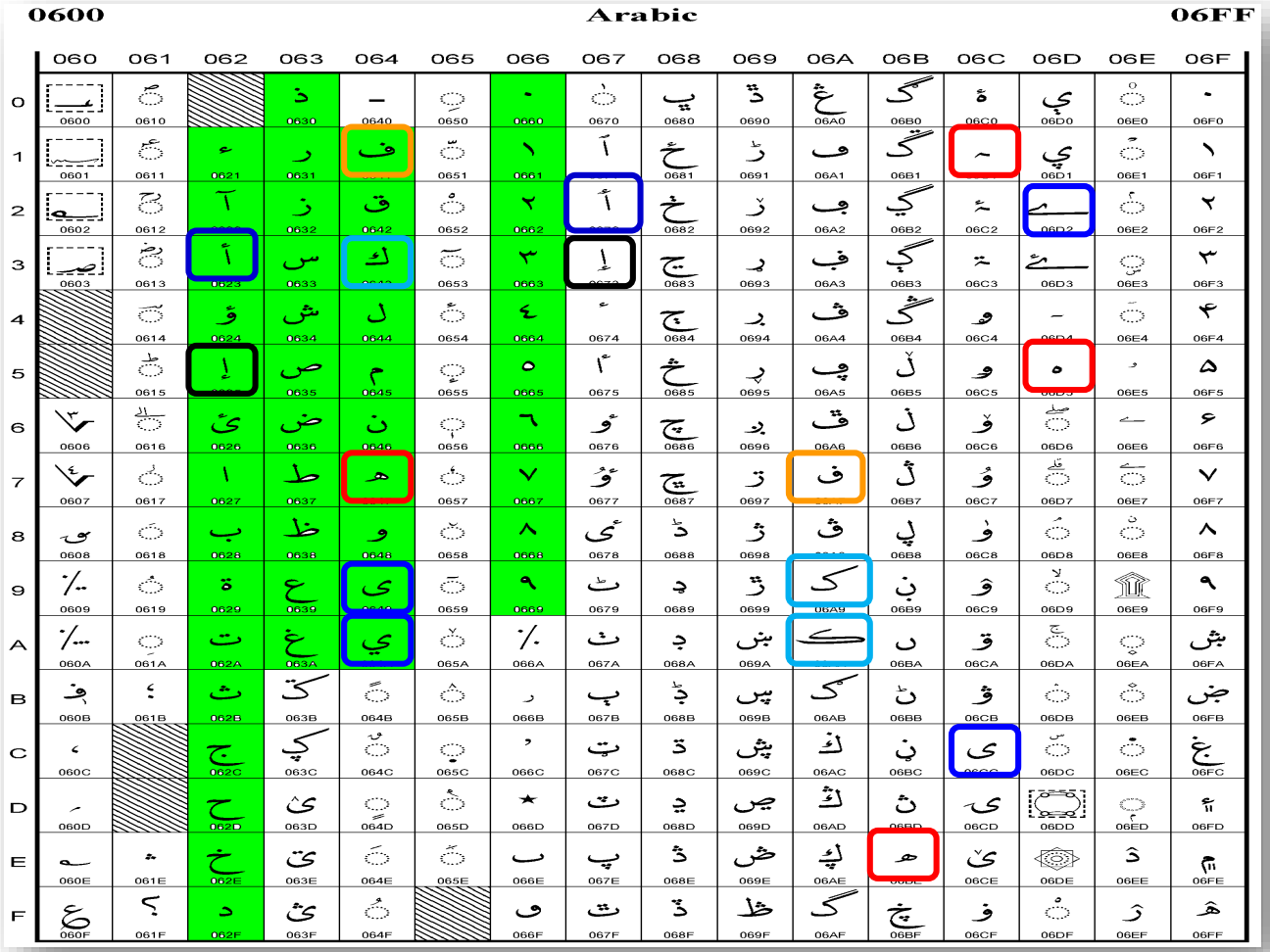
Combining Marks

ى	+	◌ٔ	=	ئ ئـ ـئـ ـئ	is confusing with	ئ ئـ ـئـ ـئ
U+0649		U+0654		U+0649 U+0654		U+0626
Description: Alef Maksura + Hamza Above <> Yeh With Hamza Above						
Comments: This is a Unicode confusable!						

ی	+	◌ٔ	=	ئ ئـ ـئـ ـئ	is confusing with	ئ ئـ ـئـ ـئ
U+06cc		U+0654		U+06cc U+0654		U+0626
Description: Farsi Yeh + Hamza Above <> Yeh With Hamza Above						
Comments: This is Unicode confusable!						

Main issues: Confusing Similar Characters

- There are a number of groups of characters that have the same shapes (Homoglyph), eg.:
  - Kaf group,
  - Heh group,
  - Yeh group,
  - Alef group
  - …

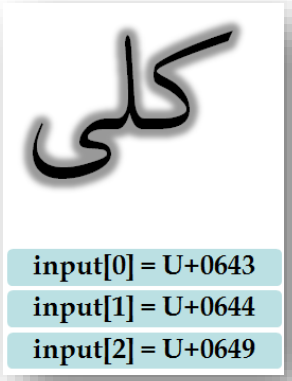


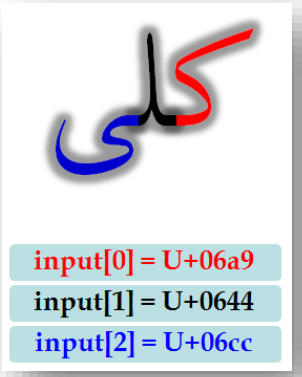
Main issues: Variants

- There are 64 “variants” for “Google.com” domain due to lower/upper case of ASCII letters.
  - If you type any of them you will reach the same site
  - The solution was done by DNS protocols
  - All are allocated and delegated
- But this is not the case for other languages!
  - Arabic (كلى) vs. Urdu (کلی)!
  - Arabic (إنترنت) vs Arabic (انترنت)

Example of ASCII Variants

Google.com
gOogle.com
goOgle.com
gooGle.com
GooGle.com
GooglE.com
...etc.

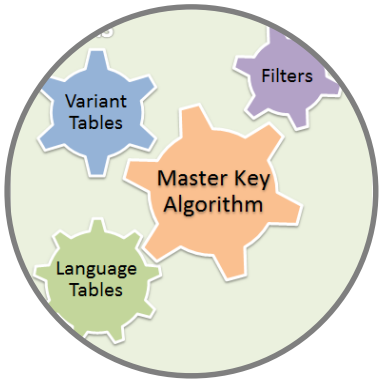




SaudiNIC's Major Efforts

Arabic IDN pilot projects

- GCC Pilot Project (2004-2005)
- Arab League (2005 - 2009)
- Language & Variant Tables



Tools, algorithms and solutions to manage variants:

- Master Key Algorithm
- Filters
- Variant Management System (VMS)

IDN Assessment Reports

Arabic Email Project (Raseel)

SaudiNIC's Major Efforts

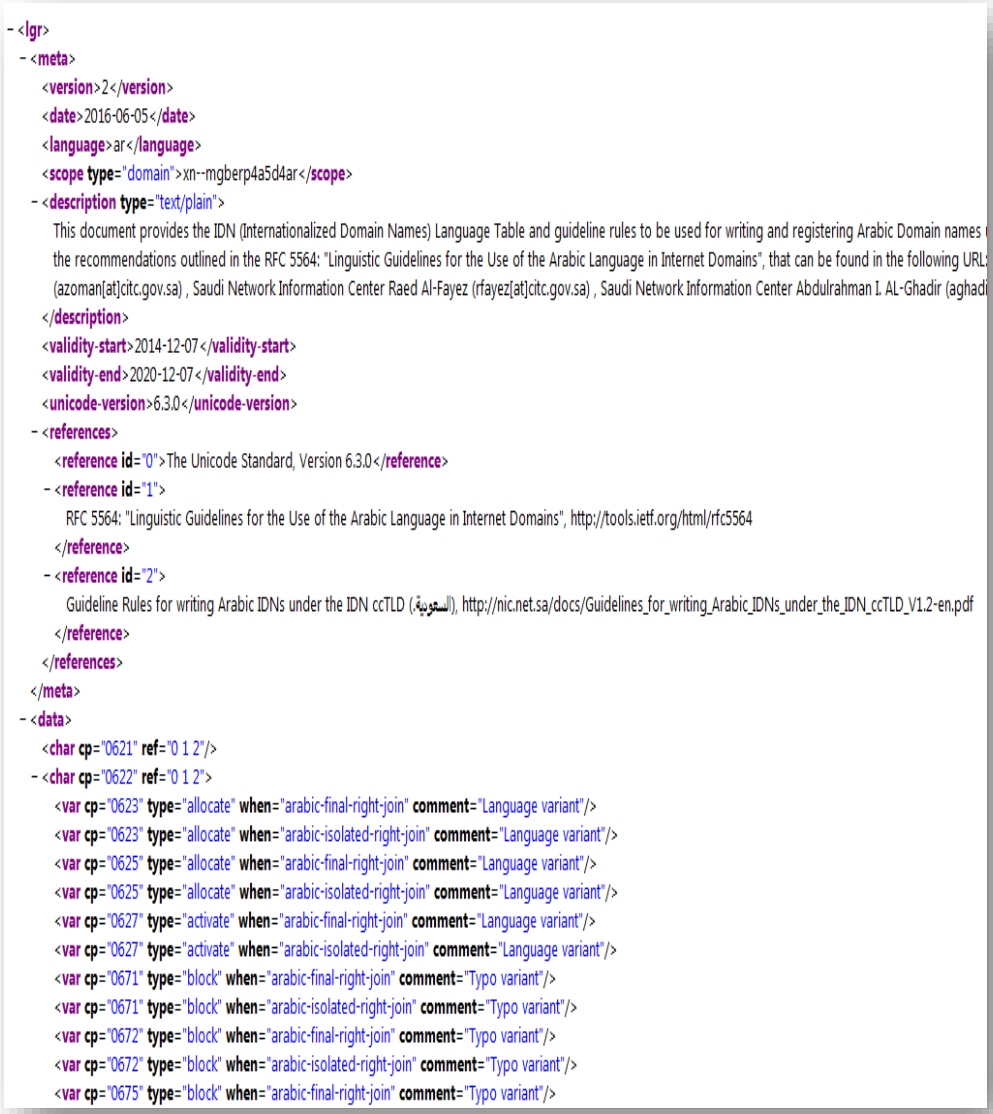
Arabic IDN pilot projects

- RFC: Linguistic Guidelines for the Use of the Arabic Language in Internet Domains
  - https://www.rfc-editor.org/rfc/rfc5564.txt

- For more information
  - http://arabic-domains.org/en/

Arabic IDN pilot projects

- Language & Variant Tables

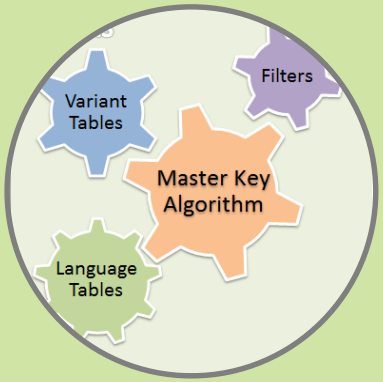


```
- <lgr>
  - <meta>
      <version>2</version>
      <date>2016-06-05</date>
      <language>ar</language>
      <scope type="domain">xn--mgberp4a5d4ar</scope>
    - <description type="text/plain">
        This document provides the IDN (Internationalized Domain Names) Language Table and guideline rules to be used for writing and registering Arabic Domain names
        the recommendations outlined in the RFC 5564: "Linguistic Guidelines for the Use of the Arabic Language in Internet Domains", that can be found in the following URL
        (azoman[at]citc.gov.sa) , Saudi Network Information Center Raed Al-Fayez (rfayez[at]citc.gov.sa) , Saudi Network Information Center Abdulrahman I. AL-Ghadir (aghadi
      </description>
      <validity-start>2014-12-07</validity-start>
      <validity-end>2020-12-07</validity-end>
      <unicode-version>6.3.0</unicode-version>
    - <references>
        <reference id="0">The Unicode Standard, Version 6.3.0</reference>
      - <reference id="1">
          RFC 5564: "Linguistic Guidelines for the Use of the Arabic Language in Internet Domains", http://tools.ietf.org/html/rfc5564
        </reference>
      - <reference id="2">
          Guideline Rules for writing Arabic IDNs under the IDN ccTLD (السعودية), http://nic.net.sa/docs/Guidelines_for_writing_Arabic_IDNs_under_the_IDN_ccTLD_V1.2-en.pdf
        </reference>
      </references>
  </meta>
- <data>
    <char cp="0621" ref="0 1 2"/>
  - <char cp="0622" ref="0 1 2">
      <var cp="0623" type="allocate" when="arabic-final-right-join" comment="Language variant"/>
      <var cp="0623" type="allocate" when="arabic-isolated-right-join" comment="Language variant"/>
      <var cp="0625" type="allocate" when="arabic-final-right-join" comment="Language variant"/>
      <var cp="0625" type="allocate" when="arabic-isolated-right-join" comment="Language variant"/>
      <var cp="0627" type="activate" when="arabic-final-right-join" comment="Language variant"/>
      <var cp="0627" type="activate" when="arabic-isolated-right-join" comment="Language variant"/>
      <var cp="0671" type="block" when="arabic-final-right-join" comment="Typo variant"/>
      <var cp="0671" type="block" when="arabic-isolated-right-join" comment="Typo variant"/>
      <var cp="0672" type="block" when="arabic-final-right-join" comment="Typo variant"/>
      <var cp="0672" type="block" when="arabic-isolated-right-join" comment="Typo variant"/>
      <var cp="0675" type="block" when="arabic-final-right-join" comment="Typo variant"/>
```

SaudiNIC's Major Efforts

Arabic IDN pilot projects

- GCC Pilot Project (2004-2005)
- Arab League (2005 - 2009)
- Language & Variant Tables



Tools, algorithms and solutions to manage variants:

- Master Key Algorithm
- Filters
- Variant Management System (VMS)

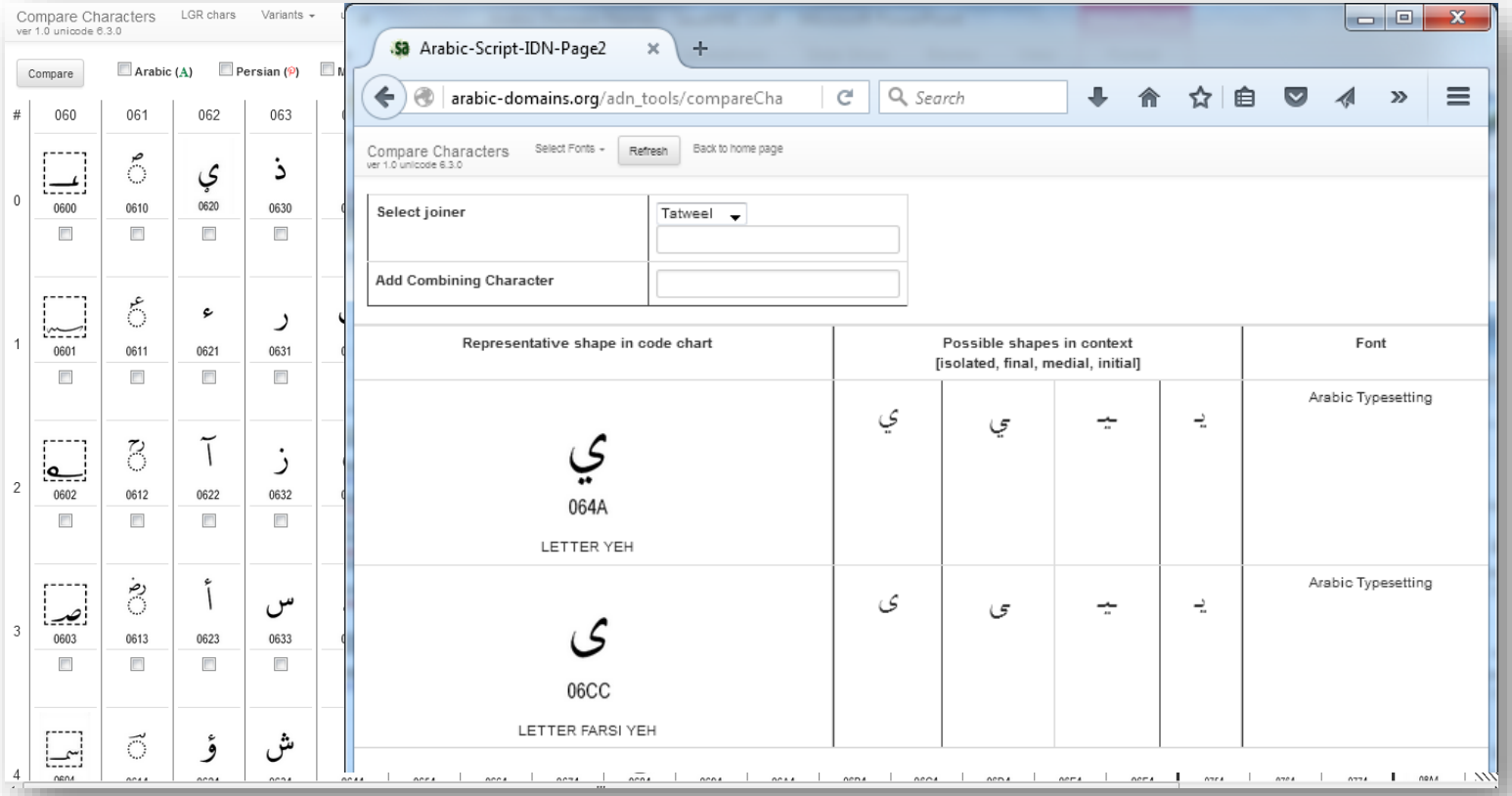
IDN Assessment Reports

Arabic Email Project (Raseel)

SaudiNIC's Major Efforts

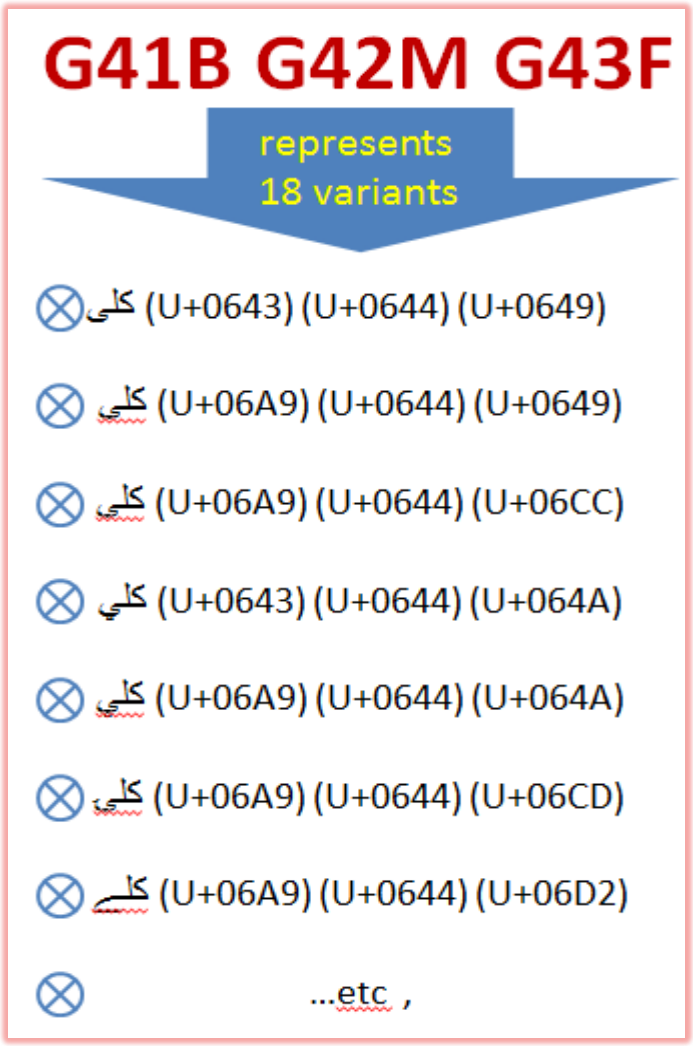
Tools and solutions: Compare Characters

- Display all code points of the whole Arabic script in one page
- Give the ability to compare code points based on their position
- It helped us to study the behavior of the code points and compare them against each other, in order to build our LT and VT.



Tools and solutions: Master Key Algorithm

- Secures the domain name space for the registry, **speeds up lookup** process and **minimizes storage** space:
  - Generates a unique key for a domain name label and all of its possible variants
  - the key can be used in the lookup process for both:
    - Domain name availability
    - Variants generation and allocation
- Supports multiple languages in a registry and it is easy to add a new language in the future
  - It requires a Language table (LT) and a Variant table (VT) for each supported language
- Provides automatic blocking of variants due to language mixing
- Supports defining variants based on character position
- Classify the relationship between variants (Exact /Typo/InterReach)
- …etc



Check the full list: http://arabic-domains.org/adn_tools/mk/index.php?T=1&M=%D9%83%D9%84%D9%89

Tools and solutions: Master Key Algorithm

- **Exponential number of variants!!!**

Label	Approximately # of variants
اتصال	300
اتصالات	6,000
الاتصالات	60,000
هيئة-الاتصالات	2,879,999
هيئة-الاتصالات-وتقنية-المعلومات	82,944,000,000

Tools and solutions: Filters (language based)

- **Goal:**
  - To reduce the huge size of allocate-able variants by intelligently identify and displaying only the desired variants
- **How?**
  - Linguistically we study words in the Arabic language to find some rules to help identifying desired variants:
    - We used N-grams model to statically study the repetitive patters in Arabic words
      - An example of 2-gram for the word " cars ": " c", "ca", "ar", "rs", "s "
      - We studied 2, 3 and 4-grams for more than **7 million non-repetitive words** in the Arabic language
      - Source: Books, Newspapers, Refereed Academic Journals.. Etc. (KACST Arabic Corpus)
    - We studied high-frequency patterns and then built some rules/filters based on them: (*الـ، *أَلـ، *آلـ ,... etc.)
  - We developed later a ranking system to arrange allocate-able variants based on weight given by each rule.
  - We have confirmed our findings with linguists and researchers.

Tools and solutions: Filters (language based)

- Sample of our variant rules (21+ rules):
  - AlefMadaEnd
    - Input:خطأ-ظمأ
    - Filtered out: خطأ-ظمآ, خطآ-ظما, خطآ-ظمآ ..etc
  - AlefHamzaDownEnd
    - Input:خطأ-ظمأ
    - Filtered out: خطأ-ظمإ, خطإ-ظما, خطإ-ظمإ..etc
  - Alf-Altareef:
    - Input:القرآن
    - Filtered out: ألقرآن, إلقرآن, آلقرآن
  - Alef-letter-Alef
    - Input:رايات
    - Filtered out: رأيآت, رإيات, رأيأت
  - .. etc.

Note
Filtered out variants are still can be allocated manually after some verification

label: مكة-المكرمة

Filtered Variants | All Variants

Results:

Master Key: G43B G41M G18F G14I G42B G43M G41M G26F G43B G18F

Statistics Summary:

Total Variants	3239
I. Must be Allocated Variants (International Reachability)	2
II. Desired Variants	4
III. Not desired Variants	28
IV. Blocked Variants	3205

I. Input:

LANGUAGE	UNICODE	LABEL
Arabic	(U+0645) (U+0643) (U+0629) (U+002D) (U+0627) (U+0644) (U+0645) (U+0643) (U+0631) (U+0645) (U+0629)	مكة-المكرمة

II. Must be Allocated Variants (2):

LANGUAGE	UNICODE	TYPO/EXACT	LABEL
Persian, Malay, Pashto	(U+0645) (U+06A9) (U+0629) (U+002D) (U+0627) (U+0644) (U+0645) (U+06A9) (U+0631) (U+0645) (U+0629)	E	مكة-المكرمة
Urdu	(U+0645) (U+06A9) (U+06C3) (U+002D) (U+0627) (U+0644) (U+0645) (U+06A9) (U+0631) (U+0645) (U+06C3)	T	مكة-المكرمة

III. Desired Variants (4):

RULES	WEIGHT	LANGUAGE	UNICODE	TYPO/EXACT	LABEL
AllocatableInInputLanguage, SameLanguage, AlAtarif, Amlat, Sync, RuleOne, RuleTwo, RuleThree, RuleFour, RuleFive, RuleSix, RuleSeven, RuleEight, RuleNine, RuleTen	4	Arabic	(U+0645) (U+0643) (U+0647) (U+002D) (U+0627) (U+0644) (U+0645) (U+0643) (U+0631) (U+0645) (U+0647)	T	مكه-المكرمه
AllocatableInInputLanguage, SameLanguage, AlAtarif, Amlat, Sync, RuleOne, RuleTwo, RuleThree, RuleFour, RuleFive, RuleSix, RuleSeven, RuleEight, RuleNine, RuleTen	2	Persian, Malay, Pashto	(U+0645) (U+06A9) (U+0647) (U+002D) (U+0627) (U+0644) (U+0645) (U+06A9) (U+0631) (U+0645) (U+0647)	T	مكه-المكرمه
AllocatableInInputLanguage, SameLanguage, AlAtarif, Amlat, Sync, RuleOne, RuleTwo, RuleThree, RuleFour, RuleFive, RuleSix, RuleSeven, RuleEight, RuleNine, RuleTen	0	Arabic	(U+0645) (U+0643) (U+0629) (U+002D) (U+0627) (U+0644) (U+0645) (U+0643) (U+0631) (U+0645) (U+0647)	T	مكة-المكرمه
AllocatableInInputLanguage, SameLanguage, AlAtarif, Amlat, Sync, RuleOne, RuleTwo, RuleThree, RuleFour, RuleFive, RuleSix, RuleSeven, RuleEight, RuleNine, RuleTen	0	Arabic	(U+0645) (U+0643) (U+0647) (U+002D) (U+0627) (U+0644) (U+0645) (U+0643) (U+0631) (U+0645) (U+0629)	T	مكه-المكرمة

IV. Not Desired Variants (28)

RULES	WEIGHT	LANGUAGE	UNICODE	TYPO/EXACT	LABEL
AllocatableInInputLanguage, SameLanguage, AlAtarif, Amlat, Sync, RuleOne, RuleTwo, RuleThree, RuleFour, RuleFive, RuleSix, RuleSeven, RuleEight, RuleNine, RuleTen	-98	Arabic	(U+0645) (U+0643) (U+0629) (U+002D) (U+0622) (U+0644) (U+0645) (U+0643) (U+0631) (U+0645) (U+0629)	T	مكة-آلمكرمة
AllocatableInInputLanguage, SameLanguage, AlAtarif, Amlat, Sync, RuleOne, RuleTwo, RuleThree, RuleFour, RuleFive, RuleSix, RuleSeven, RuleEight, RuleNine, RuleTen	-100	Arabic	(U+0645) (U+0643) (U+0647) (U+002D) (U+0622) (U+0644) (U+0645) (U+0643) (U+0631) (U+0645) (U+0629)	T	مكه-آلمكرمة
AllocatableInInputLanguage, SameLanguage, AlAtarif, Amlat, Sync, RuleOne, RuleTwo, RuleThree, RuleFour, RuleFive, RuleSix, RuleSeven, RuleEight, RuleNine, RuleTen	-98	Arabic	(U+0645) (U+0643) (U+0629) (U+002D) (U+0623) (U+0644) (U+0645) (U+0643) (U+0631) (U+0645) (U+0629)	T	مكة-ألمكرمة
AllocatableInInputLanguage, SameLanguage, AlAtarif, Amlat, Sync, RuleOne, RuleTwo, RuleThree, RuleFour, RuleFive, RuleSix, RuleSeven, RuleEight, RuleNine, RuleTen	-100	Arabic	(U+0645) (U+0643) (U+0647) (U+002D) (U+0623) (U+0644) (U+0645) (U+0643) (U+0631) (U+0645) (U+0629)	T	مكه-ألمكرمة

SaudiNIC's VMS

- An easy and stable variant management system:
  - No language mixing (utilizing the **powerful** tools: Language tables)
    - control input via the user interface
    - help identifying "must-be-allocated" variants for reachability purposes.
    - tremendously reduce the number of unnecessary allocateable variants
    - protect the TLD-space.
  - Master Key algorithm
    - Easily manage the whole variants list with one unique identifier
    - Speed up the lookup process
    - Eliminate the need of saving all possible variants
  - Must be allocated variants
    - For reachability purposes, "must-be-allocated" variants should be generated and activated automatically by the registry, so that: registered domain name is accessed regardless of the input devices (language table) being used by the navigator users.
  - Filters
    - To identify desired allocatable variants

SaudiNIC's VMS: international reachability

- For reachability purposes, variants should be addressed to be activated automatically by the registry, so that:
  - A registered domain name is accessed regardless of the input devices (language table) being used by the navigator users.
  - For example:
    - A user registered the domain "مكة" (all characters from the Arabic language)
    - if another user try to reach that domain name from an Internet café in Pakistan he/she will type "مکة" (all characters from the Urdu language)
    - If the "must-be-allocated" variants were not allocated, delegated and hosted then the domain name will not be reachable.

LANGUAGE	UNICODE	LABEL
Arabic	(U+0645) (U+0643) (U+0629)	مكة
Persian, Malay, Pashto	(U+0645) (U+06A9) (U+0629)	مكة
Urdu	(U+0645) (U+06A9) (U+06C3)	مكة

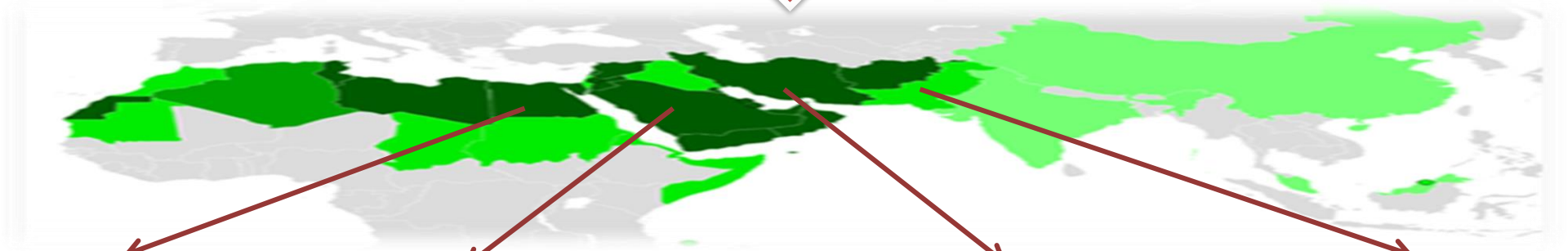
Hence, reachability issue (based on input devices used by other language communities) should be carefully considered when defining variants (by language communities).

(0643) ك

(06A9) ک

SaudiNIC's VMS: Registrant will use his/her keyboard

مكة



مكة
U+0645
U+0643
U+0629

مكه
U+0645
U+0643
U+0647

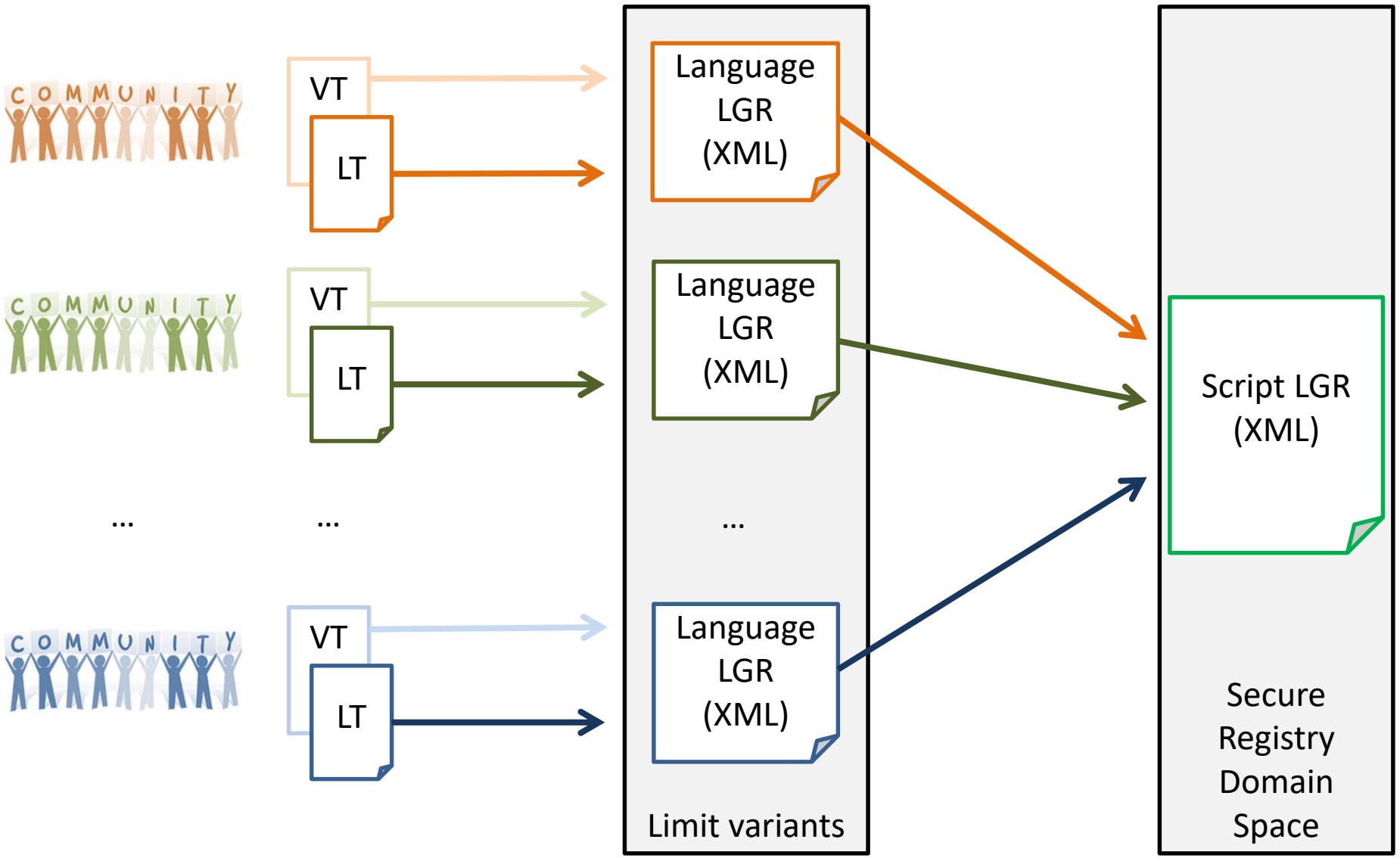
مكه
U+0645
U+06A9
U+0647

مكہ
U+0645
U+06A9
U+06C1

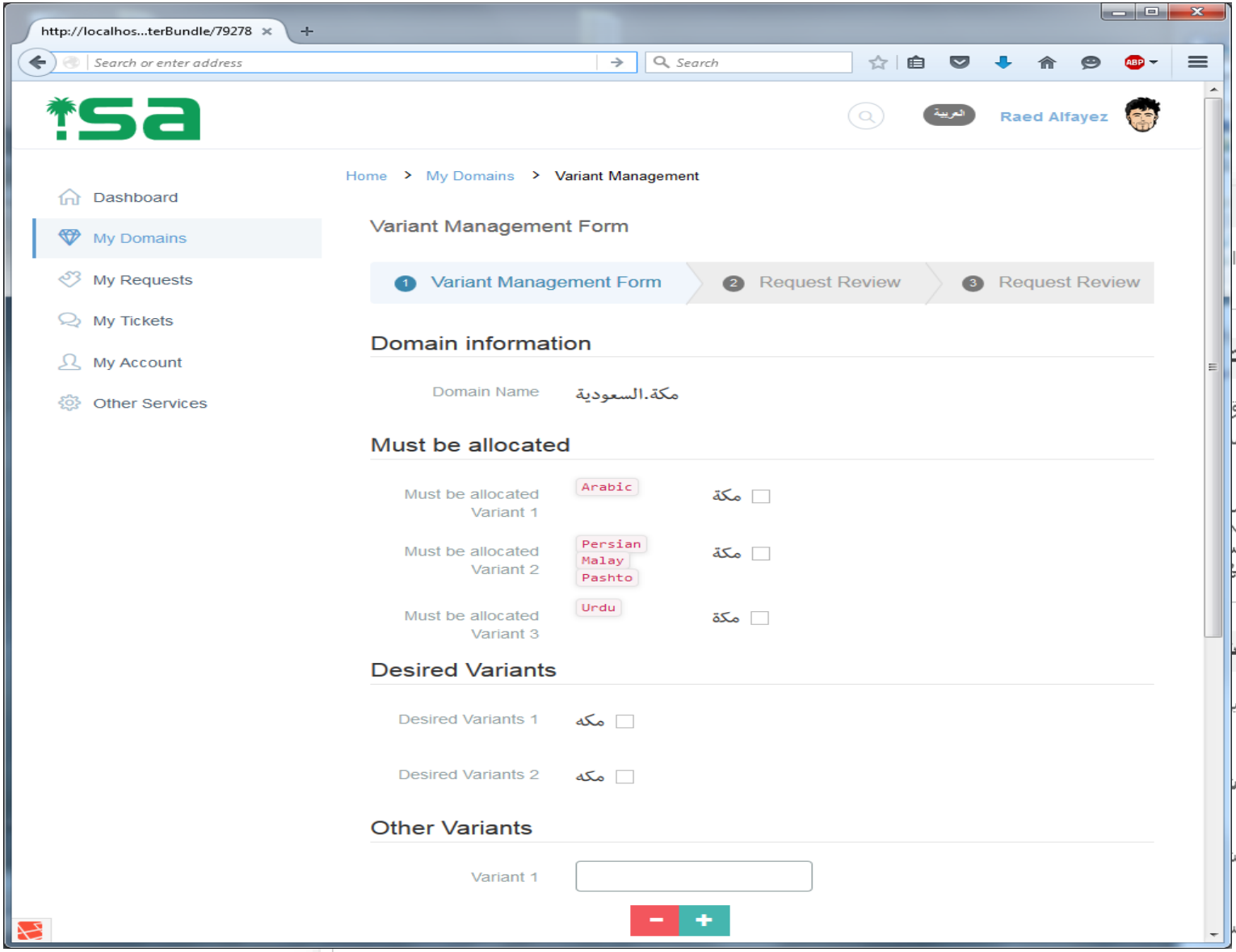
SaudiNIC's VMS: blocking quality??

IDN	Total Variants	Allocatable	Blocked	Blocked due to Language Mixing
مكة-المكرمة	3239	34	3205	3181 (99.25%)
القرآن-الكريم	11999	111	11888	11836 (99.56%)
هيئة-الإعلام	47999	81	47918	47764 (99.68%)
كهف-الياسمين	28799	65	28734	28680 (99.81%)
كهف-اكيا	21599	47	21552	21534 (99.92%)

SaudiNIC's VMS: Language LGR and Script LGR



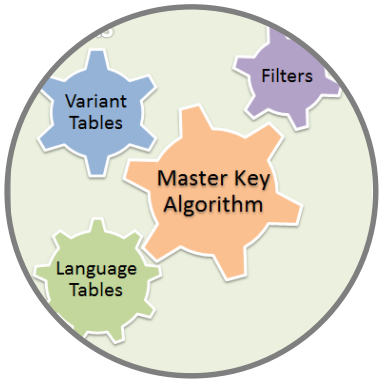
SaudiNIC's VMS: Easy interface for registrants



SaudiNIC's Major Efforts

Arabic IDN pilot projects

- GCC Pilot Project (2004-2005)
- Arab League (2005 - 2009)
- Language & Variant Tables



Tools, algorithms and solutions to manage variants:

- Master Key Algorithm
- Filters
- Variant Management System (VMS)

IDN Assessment Reports

Arabic Email Project (Raseel)

SaudiNIC's Major Efforts

IDN Assessment Reports

Conducted and Published a number of IDN Assessment Reports:

2007

- IDN Top Level Domain Evaluations and Testing Report
- with the cooperation of the Arabic Domain Name Pilot Project Team.

2010

- Arabic IDN Test Results for Browsers
- Mozilla Firefox & Microsoft IE

2014

- IDN Assessment Report

SaudiNIC's Major Efforts

Arabic IDN pilot projects

- GCC Pilot Project (2004-2005)
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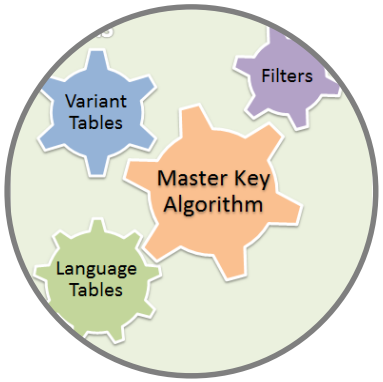

Tools, algorithms and solutions to manage variants:

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IDN Assessment Reports

Arabic Email Project (Raseel)

SaudiNIC's Major Efforts

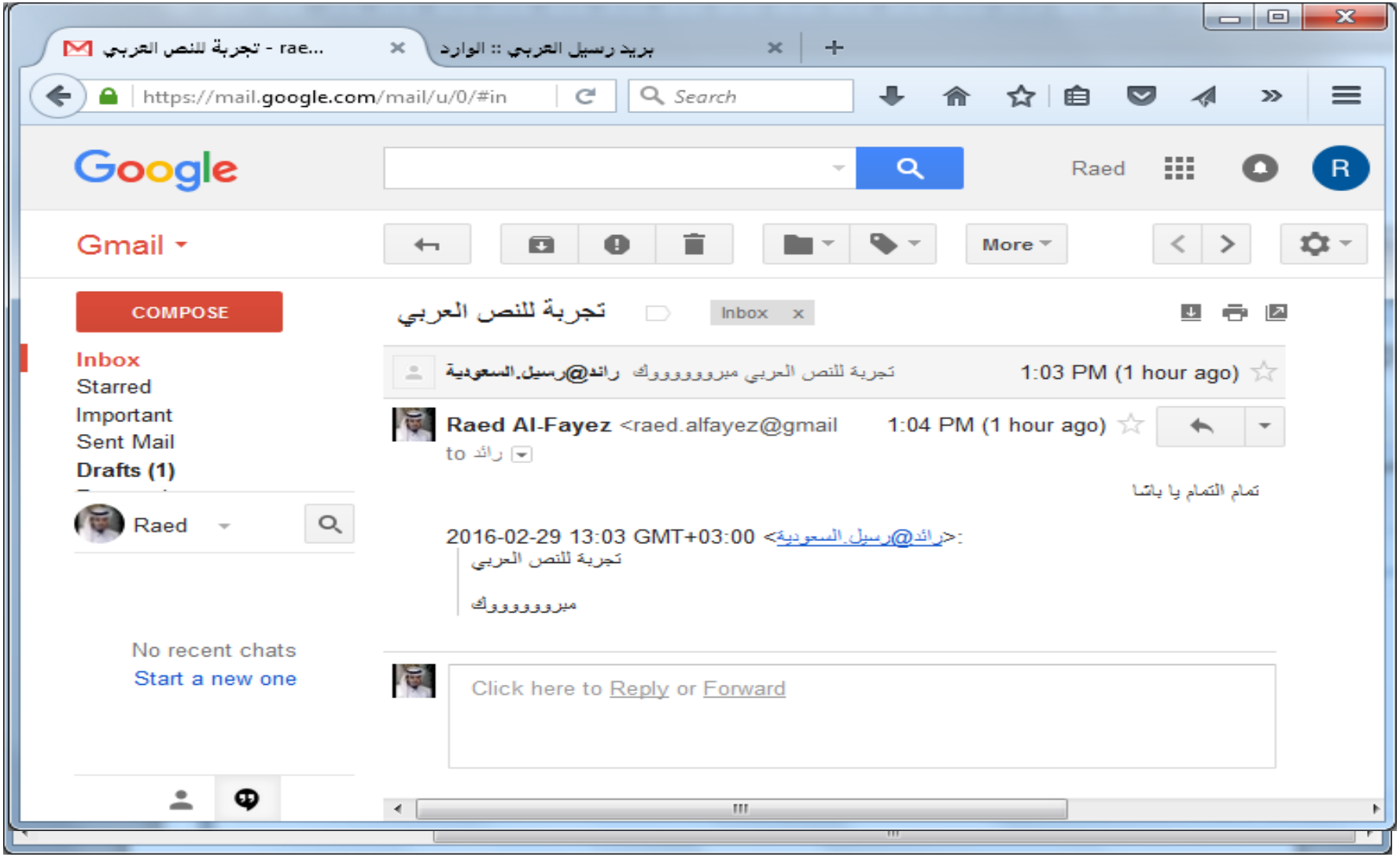
Raseel: An Arabic Email System

- **Phase I (2010~2013):**
  - A pilot project to test Arabic email addresses
  - Built before the EAI RFCs
    - Using a hack: convert the user part of the email address to Punycode
    - Implemented plugins for Outlook and Roundcube to display the Arabic addresses correctly.
  - Work with existing Email Servers and old RFCs.

Raseel: An Arabic Email System

- **Phase II (2016+):**
  - Built based on the new EAI RFCs using standard EAI addresses
    - Postfix, Horde/Roundcube and Archiveopteryx
  - Still in a beta version and not open for public.
  - Successful test internally and with Gmail and MS Outlook.
  - No need for plugins.

Raseel: An Arabic Email System



Raseel: An Arabic Email System

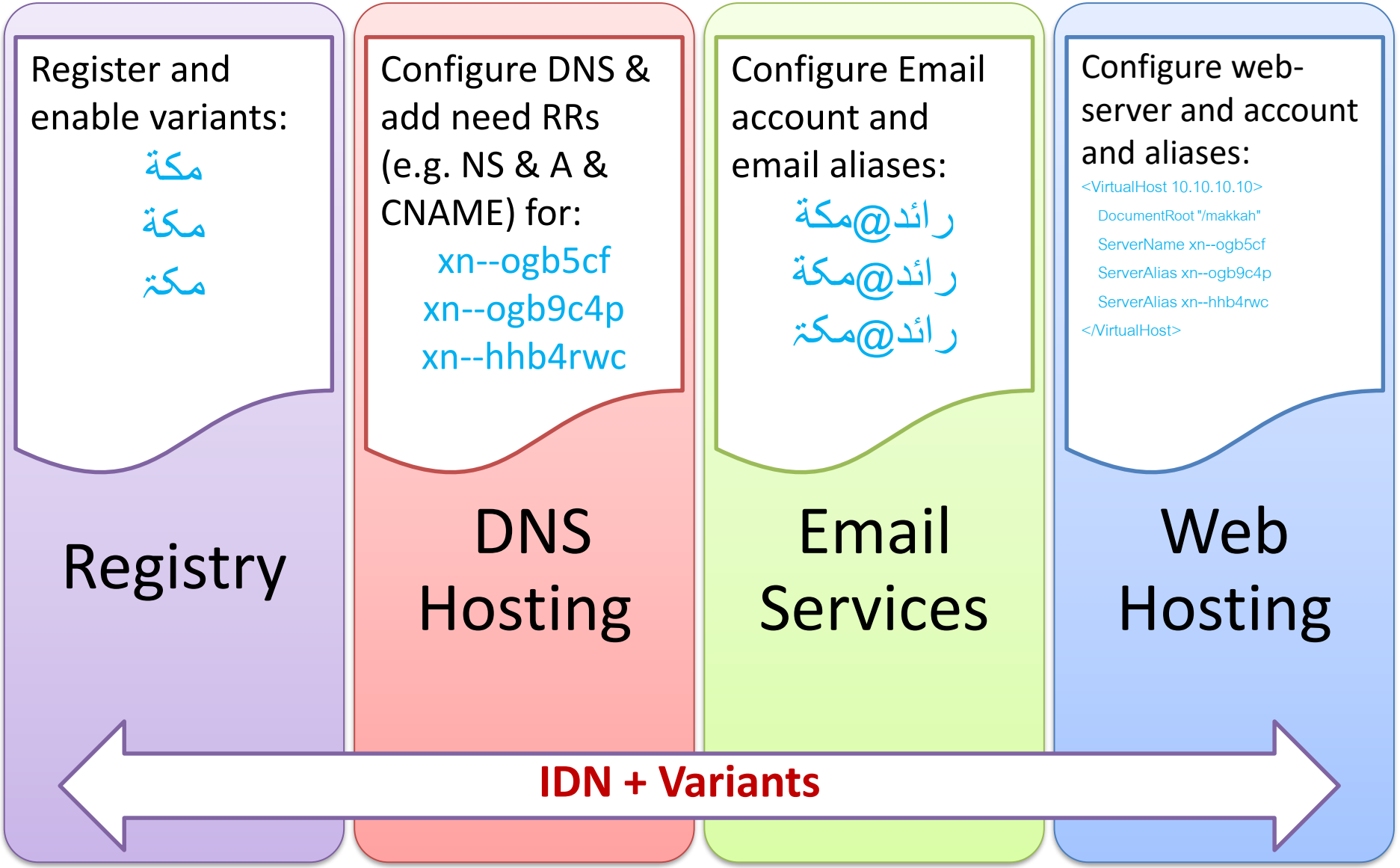
- Almost 5 years since the EAI RFCs were published and until now there are almost no support (or very limited) in:
  - Email servers (SMTP, IMAP, POP),
  - Email providers (Gmail, Hotmail, Yahoo)
  - Emails clients (Webmail, Application)
- Need to have a protection mechanism for the user part of the emails addresses (similar to IDN variants)

بريد@رسيل.السعودية	بريد@رسيل.السعودية
Farsi Yeh (U+06CC)	Arabic Yeh(U+064A)

- Automatic tools to configure and manage variants (Domain, User Accounts).
- Boosting the adoption of the new EAI RFC by ISP and service/hosting providers.

WHAT IS MISSING?

Variants enablement must be done in every level



Gift

- Published "**SaudiNIC's Best Practices in Supporting and Managing Arabic Domain Names**"
  - http://www.nic.sa/docs/SaudiNIC_ADNBP.pdf

Thank you

شكرًا

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