Programming to Support Universal Acceptance

APAC Universal Acceptance Training Program
An APTLD-ICANN Collaboration

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13 April 2021

Joint APTLD-ICANN APAC UA Training Program

Date	Session	Audience	Description
20 January 2021 1:00 UTC	Configuring for Email Address Internationalization (EAI)	Technical (system engineers)	A detailed training on how to configure email systems to support EAI
13 April 2021	Programming for supporting Universal Acceptance	Technical (programmers)	A detailed training on how to design and develop applications and systems to support UA
5 May 2021 (tentative)	Universal Acceptance: Its Impact and Next Steps	ccTLD managers, local regulators, tech, and business	A dialogue on how UA issues impact the APAC community, how best to address these issues, and highlight business opportunities by being UA-ready

- Additional follow-up webinars or face-to-face meetings (when possible) may be scheduled based on the discussions held during these training sessions.
- Further details published by APTLD and ICANN.

Agenda

- Overview of Universal Acceptance (15 minutes)
  - Quiz (5 minutes)
- Fundamentals for IDNs and EAI (15 minutes)
  - Quiz (5 minutes)
- Programming for UA using Java - 1 (15 minutes)
  - Break (5 minutes)
- Programming for UA using Java - 2 (20 minutes)
- Conclusion (5 minutes)
- Q&A (10 minutes)

Overview of Universal Acceptance

Universal Acceptance of Domain Names and Email

Goal

All domain names and email addresses work in all software applications.

Impact

Promote consumer choice, improve competition, and provide broader access to end users.

Categories of Domain Names and Email Addresses

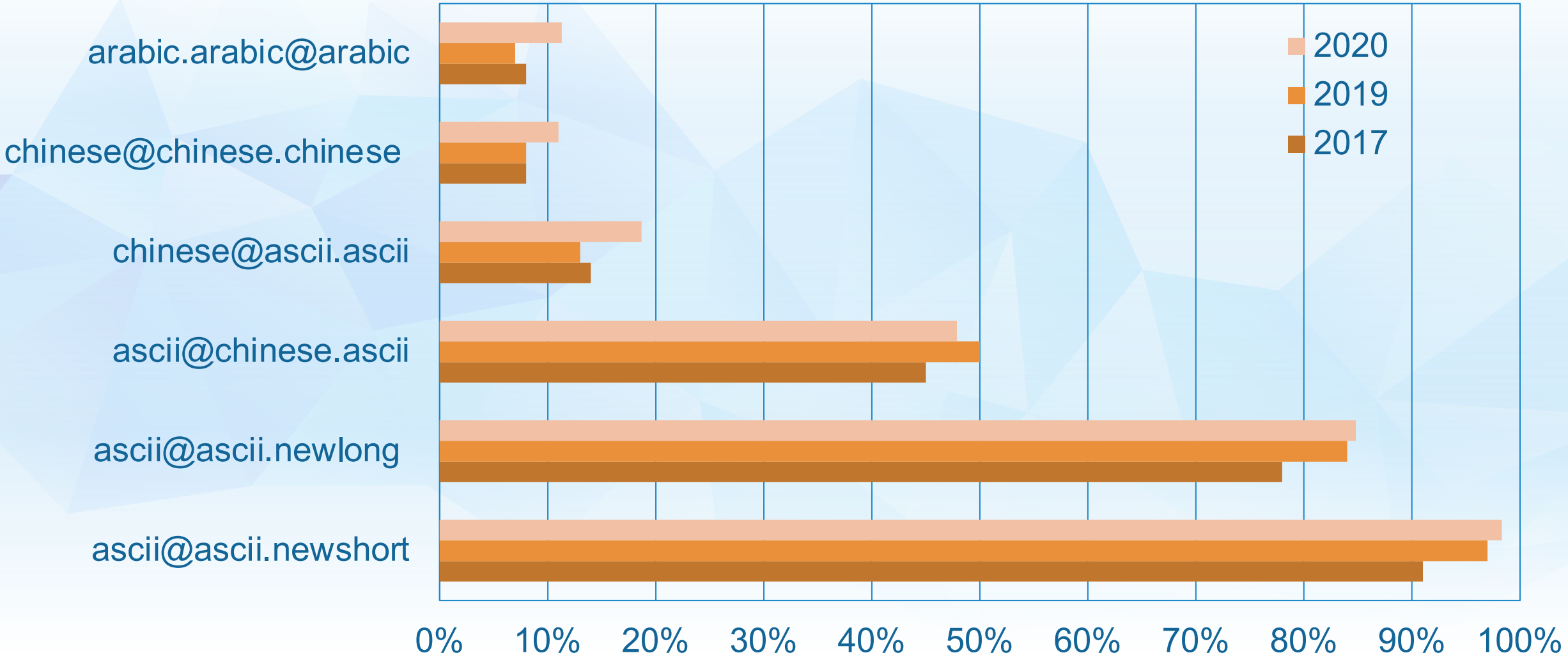
- It's now possible to have domain names and email addresses in local languages using UTF8.
  - Internationalized Domain Names (IDNs)
  - Email Address Internationalization (EAI)

- Domain names
  - **Newer** top-level domain names: example.sky
  - **Longer** top-level domain names: example.abudhabi
  - **Internationalized** Domain Names: 普遍接受-测试.世界

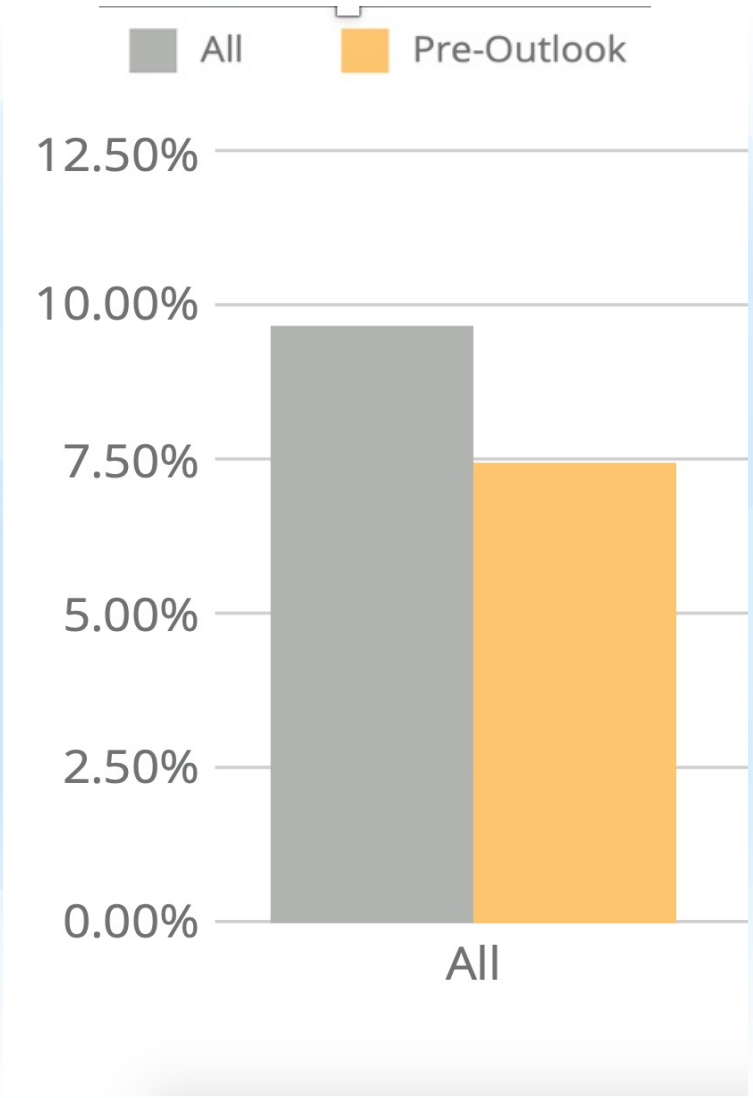
- Internationalized email addresses (EAI)
  - ASCII@IDN: marc@société.org
  - UTF8@ASCII: ईमेल@example.com
  - UTF8@IDN: 测试@普遍接受-测试.世界
  - UTF@IDN; right-to-left scripts: ای-میل@مثال.موقع

Acceptance of Email Addresses by Websites Globally

For details, see UASG027



Estimated Support of EAI in Email Systems Under All TLDs



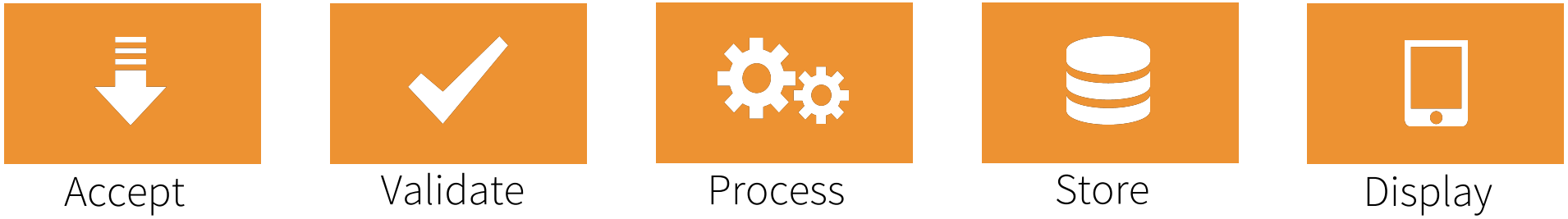
Only 9.7% of the domains sampled were EAI ready in 2019.

This is based on mail servers found through MX records in zones of all top-level domains (TLDs).

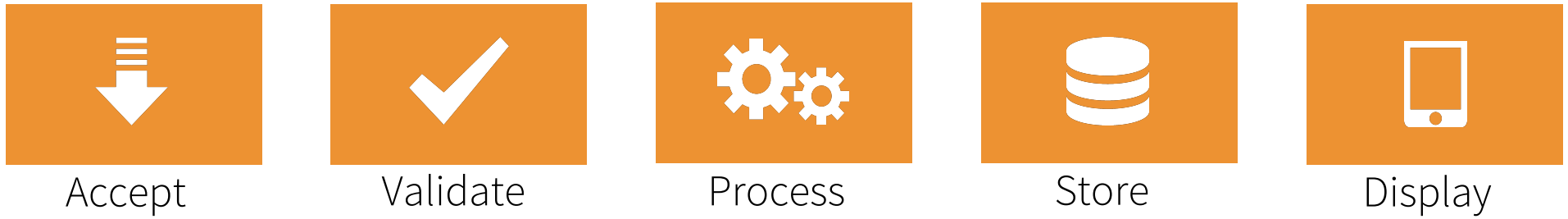
For details on methodology, see UASG021D: EAI Readiness in TLDs

Scope of UA Readiness for Programmers

1. Support All Domain Names



2. Support All Email Addresses



Technology Stack for UA Consideration

Applications and Websites

- Wikipedia.org, ICANN.org, Amazon.com, custom websites globally
- PowerPoint, Google-Docs, Safari, Acrobat, custom apps

Social Media and Search Engines

- Chrome, Bing, Safari, Firefox, local (e.g., Chinese) browsers
- Facebook, Instagram, Twitter, Skype, WeChat, WhatsApp, Viber

Programming Languages and Frameworks

- JavaScript, Java, Swift, C#, PHP, Python
- Angular, Spring, .NET core, J2EE, WordPress, SAP, Oracle

Platforms, Operating Systems and Sytem Tools

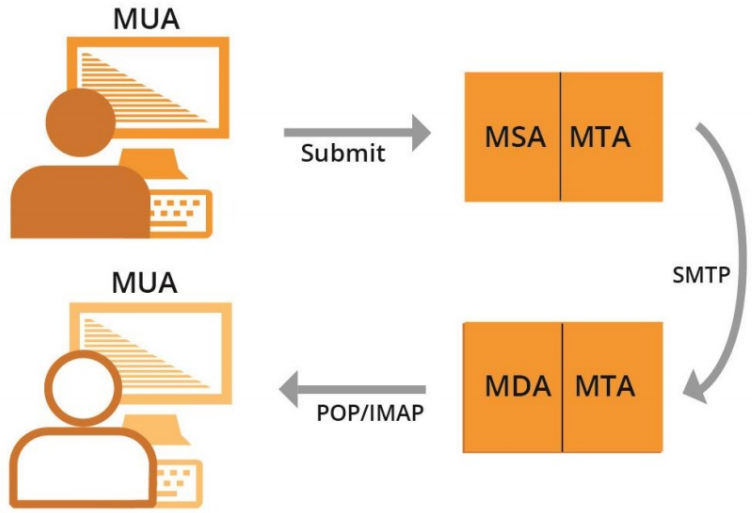
- iOS, Windows, Linux, Android, App Stores
- Active Directory, OpenLDAP, OpenSSL, Ping, Telnet

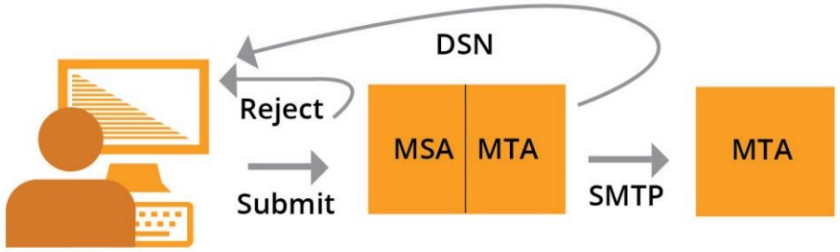
Standards and Best Practices

- IETF RFCs, W3C HTML, Unicode CLDR, WHATWG
- Industry-based standards (health, aviation, ...)

Email Systems

- All email agents must be configured to send and receive internationalized email addresses. See EAI: A Technical Overview for details.
  - MUA – Mail User Agent: A client program that a person uses to send, receive, and manage mail.
  - MSA – Mail Submission Agent: A server program that receives mail from a MUA and prepares it for transmission and delivery.
  - MTA – Mail Transmission Agent: A server program that sends and receives mail to and from other Internet hosts. An MTA may receive mail from an MSA and/or deliver mail to an MDA.
  - MDA – Mail Delivery Agent: A server program that handles incoming mail and typically stores it in a mailbox or folder.





Quiz

Quiz 1 Question

- To enhance systems to be Universal Acceptance (UA) ready, which of the following categories of domain names and email addresses are relevant?
  1. ASCII domain names.
  2. Internationalized Domain Names (IDNs).
  3. Internationalized email addresses.
  4. All the above.
  5. Only 2 and 3.

Fundamentals for Internationalized Domain Names and Email Addresses

Unicode Encoding

- Unicode encodes glyphs into codepoints for different scripts of the world.
  - Codepoints shown in hex using the U+XXXX notation.
  - Unicode files typically in UTF8 format, using a variable number of bytes for a codepoint.
  - ASCII is used as is in Unicode: e = ASCII 65 = U+0065.
- There are multiple ways to encode certain glyphs in Unicode:
  - è = U+00E8
  - e + ` = è = U+0065 + U+0300
- Normalization ensures that the end representation is the same, even if users type differently.
  - IDN standards recommend using Normalization Form C (NFC).
  - Generates U+00E8 for both versions above.

Domain Names and Internationalized Domain Names (IDNs)

- A domain name is an ordered set of labels or strings: www.example.co.uk.
  - The top-level domain (TLD) is the rightmost label: ”uk”
  - Previously, TLDs were only two or three characters long (e.g., .ca, .com).
  - Now TLDs can be longer strings (e.g., .info, .google, .engineering).
  - TLDs delegated in the root zone can change over time, so a fixed list can get outdated.
- Domain names can also be internationalized when one of the labels contains at least one non-ASCII character.
  - For example: www.exâmple.ca or 普遍接受-测试.世界.
- Use the latest IDN standard called IDNA2008 for IDNs.
  - Do not use libraries for the outdated IDNA2003 version.

IDNs and EAI

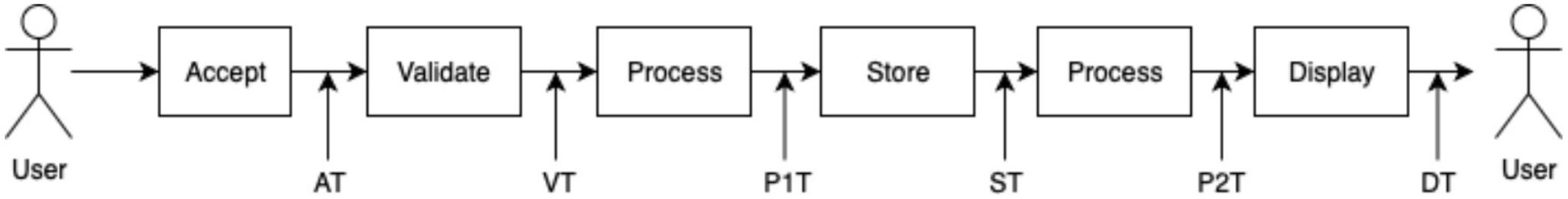
- There are two equivalent forms of IDN domain labels.
  - Human users use the IDN version called U-label (using UTF-8 format): exâmple
  - Applications or systems internally use an ASCII equivalent called A-label:
    1. Take user input and normalize to form U-label
    2. Convert U-label to punycode (using RFC3492)
    3. Add the “xn--” prefix is added to identify the ASCII string as an IDN
       - exâmple => exmple-xta => xn--exmple-xta
       - 普遍接受-测试 => --f38am99bqvcd5liy1cxsg => xn----f38am99bqvcd5liy1cxsg
- Email address syntax: mailboxName@domainName
  - EAI has the mailboxName in Unicode (in UTF8 format).
  - The domainName can be ASCII or IDN.
    - For example: kévin@example.org or すし@快手.游戏.

Universal Acceptance Issues

- Some applications are still verifying domain names incorrectly by using one of the outdated methods:
  - Check for a fixed length of TLD between 2-4 characters (TLD can be up to 63 characters).
  - Check from a fixed set of TLDs, e.g., using static list of strings.
  - Check for only ASCII characters.
- Some applications do not cater to additional requirements for validating EAI:
  - Check mailbox name to be a valid string in UTF-8 format.
  - DomainName can be ASCII or IDN.

UA Readiness Testing Framework

- Based on UASG026, the application components can be generalized to put emphasis on the processing of internationalized identifiers.
- Each gate has its own set of requirements and processing.



- AT: Accept test
- VT: Validate test
- P1T: Process test on the input
- ST: Store test
- P2T: Process test on the output
- DT: Display test

Validating User Input

- Validating user input, or any input, is extremely useful for various reasons, some of which include: a better user experience, increased security, and avoiding irrelevant issues.
- Validating domain names and email addresses is useful.
- Some validation methods for domain names and email addresses:
  - Basic syntax checks: is the syntax of the string correct?
    - Does the domain name contain '.' ?
    - Does the email address contain '@' and a valid domain name part?
  - Functional checks: does the domain name or email address work?
    - Is the top-level domain (TLD) in use?
    - Is the whole domain name in use?
    - Is the email in use?

Validating Domain Name

- Validating syntax:
  - ASCII: RFC1035
    - Composed of letters, digits, and hyphen.
    - Max length is 255 octets with each label up to 63 octets.
  - IDN: IDNA2008 (RFCs 5890-5894)
    - Valid A-labels
    - Valid U-labels
- Validating function:
  - Is the top-level domain (TLD) in use?
    - Verify against the list of TLDs.
    - Verify using a DNS request.
  - Is the whole domain name in use?
    - Verify using a DNS request.

Resolving Domain Name

- After validation, a software would then use the domain name identifier as:
  - A domain name to be resolved in the DNS.
- Therefore, to be UA compliant, the software has to use proper methods that support UA.
  - For example, passing a U-Label to the traditional functions or methods may not succeed, as it is not expecting a UTF8 domain name.

Validating Email Address

- An email address is composed of: mailboxName@domainName
- Validating syntax:
  - For domainName, see earlier discussion.
  - For mailboxName:
    - ASCII
    - UTF8 (for EAI)
- Validating function:
  - Is the domain name set up to send and receive emails?
  - Is the mailbox name able to send and receive emails?

Sending Email

- After validation, a software would then use the email identifier as:
  - An email-address based user id.
  - To send an email.
- Therefore, to be UA compliant, the software must use proper methods that support UA.
  - For example, passing an UTF8 mailbox name email address to a mail sender may not succeed, as it is not expecting a UTF8 mailbox name in the email address.

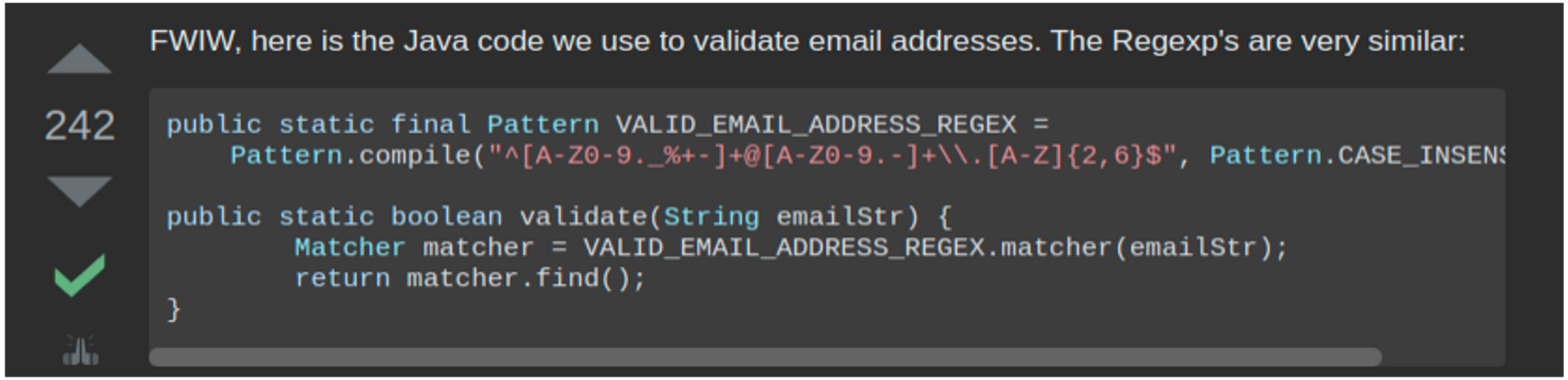
Sending Email

- A comprehensive list of UA test cases is documented in UASG004.
- Developers are strongly encouraged to use these test cases in its unit and system testing.

Quiz

Quiz 2: A Real Example

- A company built a website where international consumers can subscribe via their email. Since the subscription form is user input, developers validated the email address before trying to send the email.
  - Developers went to Stackoverflow and found a regular expression (regex) to perform the validation:



  - The regex limits mailbox to letters A-Z, digits 0-9, and some symbols, the domain labels to letters, digits and hyphen, and the top-level domain to letters with length 2-6.

- Would this regex work for the company's website? Why or why not?

Programming for UA using Java

Java Version

- Code examples were tested against Java 11 (Oracle version) and Android API/SDK 26 where applicable.
  - It is possible that older versions have issues.
- Some libraries may require (not necessarily because of UA) newer versions of Java.
- Unless explicitly stated, this tutorial should apply to any VM flavor:
  - Oracle, OpenJDK, or Android (Dalvik/ART).

Java Library Versions

- This tutorial shows many libraries as found in the field. While the list is not exhaustive, it is still comprehensive to help you assess which and how to use a library, specially if the software has already been developed.
  - UASG report provides detailed information about the libraries compliant with UA. See https://uasg.tech/wp-content/uploads/documents/UASG018A-en-digital.pdf.
- Libraries shown in this tutorial have been tested on the current version available at the time of writing.
  - It's possible that new versions of some libraries have fixed issues or made enhancements that would change the recommendations.
  - Please check at the time of your development the status of these libraries.

Type Holder for UA Identifiers

- UA identifiers are domain names and email addresses.
  - These identifiers may contain Unicode UTF8 data.
- Java String type is well-suited to hold those identifiers as it is natively supporting Unicode. Therefore, most libraries expect the String type.
- Default charset (Charset.defaultCharset()) is typically UTF8 in most systems. Verify (java -XshowSettings) or change the default charset in the Java VM you are using.
  - For more info, see JEP.

Some Basic Test Cases

- The code examples throughout the tutorial will use these inputs, which provide basic UA test cases (non-exhaustive):

```
List<String> testDomains = List.of(
   "example.org",                  // ascii.ascii
   "example.undefinedtld",         // unexistant tld
   "example.recentTld",            // recently allocated tld
   "example.accountants",          // allocated longer than 7 char tld
   "exâmple.org",                  // ulabel.ascii
   "xn--exmple-xta.org",           // alabel.ascii
   "exâmple.ไทย",                  // ulabel.ulabel
   "exâmple.xn--o3cw4h",           // ulabel.alabel
   "xn--exmple-xta.xn--o3cw4h"     // alabel.alabel
 );
 List<String> testLocalParts = List.of(
   "user",
   "kévin"
 );
```

Domain Names

Java Libraries Versions

- Traditional way of doing hostname resolution and sockets resolution:

```
import java.net.InetAddress;
getByName(String host);
getAllByName(String host);
Socket(String host, int port);
```

  - Uses underlying getByName()

- Throws a UnknownHostException for any failure:
  - No IP addresses returned
  - Invalid host
  - Bad syntax
  - ...

- Passes the host String as is to the underlying OS, without validation.
  - Therefore, invalid domains (such as invalid U-labels) are passed.
  - Depends on the implementation of the underlying OS.

Using Plain Java: Recommendation

- Do not use as-is with a hostname. Instead:
  - Prepare the hostname (e.g., convert IDN U-label to A-label) using another library and then use these base calls.
  - Validate the hostname before calling getByName()
    - To avoid delays waiting for answers of queries that will throw anyway.
    - Provide better feedback to the user because the throw will not tell you if the hostname was wrong or if the hostname was OK, but the query did not return data.

International Components for Unicode (ICU)

- The gold standard library for Unicode. It was developed by IBM and is now managed by Unicode. In sync with Unicode standards.
  - ICU4J (http://site.icu-project.org/home) is not really Java-ized. It is a direct mapping to the C version. Java developers may not like it for that reason.
  - IDNA Conversion is based on Unicode UTS46, which supports transition from IDNA2003 to IDNA2008. However, it is possible to configure not to support transition (recommended).
  - IDNA Conversion includes normalization as per IDNA (good!).
  - The output of the methods may contain bad domain names as disallowed characters are replaced by U+FFFD.
  - Check if there are errors in the conversion by calling info.hasErrors().
  - For IDNs, set the options to restrict the validation and use to IDNA2008.
  - The static methods implement IDNA2003, and non-static methods implement IDNA2008.

ICU Usage

- Maven Repository:

```
<dependency>
 <groupId>com.ibm.icu</groupId>
 <artifactId>icu4j</artifactId>
 <version>65.1</version>
</dependency>
```

```
import com.ibm.icu.text.IDNA;
IDNA validator = IDNA.getUTS46Instance(
    IDNA.NONTRANSITIONAL_TO_ASCII
  | IDNA.NONTRANSITIONAL_TO_UNICODE
  | IDNA.CHECK_BIDI
  | IDNA.CHECK_CONTEXTJ
  | IDNA.CHECK_CONTEXTO
  | IDNA.USE_STD3_RULES);
StringBuilder output = new StringBuilder();
IDNA.Info info = new IDNA.Info();
validator.nameToASCII(input, output, info);
if (info.hasErrors()) {}
```

Option not to use UTS46 transitional feature and to enhance validation.

Xcode

- Utility library developed by Verisign. Has an "Idna" object.
  - https://www.verisign.com/en_US/channel-resources/domain-registry-products/idn-sdks/index.xhtml
  - No Maven Repository (only a zip downloadable with a jar file in it).
  - Slow (tests show the processing of a domain can take up to 5 seconds) but implements IDNA2008 perfectly.

```
import com.vgrs.xcode.common.Unicode;
import com.vgrs.xcode.idna.Idna;
import com.vgrs.xcode.idna.Punycode;
 Idna idna = new Idna(new Punycode(), true, true);
 int[] output = idna.domainToUnicode(input.toCharArray());
        // see domainToAscii for roundtrip
 String domain = new String(Unicode.decode(output));
```

Other Libraries

- JRE-IDN
  - Included in JRE but implements IDNA2003.
- Apache Common Validator
  - Has domain and email validators.
  - Do not use as it relies on a static list of TLDs! OUTDATED!
- Guava
  - Utility library developed by Google.
  - Not useful for validation.
  - If used, be aware that it depends on the public suffix list, statically set into the library, so you would need to update the library frequently.

Making an HTTP Request

HTTP Client	Accept UTF8 Form	Normalization	Automatic Conversion	IDNA2008
Java 1.1 HttpURLConnection	✗	✗	✗	✗
Apache HTTP Client	✗	✗	✗	✗
OkHTTP	✓	✓	✓	✗
Java 11 HTTP Client	✗	✗	✗	✗
Google Java HTTP Client	✗	✗	✗	✗

Email Addresses

Validating Email

Email Regular Expressions (Regex)

- Basic: something@something
  - ^(.+)@(.+)$
- From owasp.org (security):
  - [^[a-zA-Z0-9_+&*-]+(?:\.[a-zA-Z0-9_+&*-]+)*@(?:[a-zA-Z0-9-]+\.)+[a-zA-Z]{2,7}$]
    - Does not support EAI, i.e., mailbox name in UTF8 not allowed: [a-zA-Z0-9_+&*-]
    - Does not support ASCII TLD longer than 7 characters: [a-zA-Z]{2,7}
    - Does not support U-labels in IDN TLD: [a-zA-Z]
  - But OWASP is THE reference for security.
    - Therefore, you may end up fighting with your security team to use a UA-compatible Regex instead of the “standard” one from OWASP.

Email Regular Expressions (Regex)

- Example of Regex suggested in various forums: ex: List of proposals
  - ^[A-Za-z0-9+_.-]+@(.+)$ does not support UTF8 in mailbox name
  - ^[a-zA-Z0-9_!#$%&'*+/=?`{|}~^.-]+@[a-zA-Z0-9.-]+$ does not support U-labels
  - ^[a-zA-Z0-9_!#$%&'*+/=?`{|}~^-]+(?:\\.[a-zA-Z0-9_!#$%&'*+/=?`{|}~^-]+)*@[a-zA-Z0-9-]+(?:\\.[a-zA-Z0-9-]+)*$ does not support U-labels
  - ^[\\w!#$%&'*+/=?`{|}~^-]+(?:\\.[\\w!#$%&'*+/=?`{|}~^-]+)*@(?:[a-zA-Z0-9-]+\\.)+[a-zA-Z]{2,6}$ have length restrictions for the TLD between 2 – 6 characters
- One can come up with an EAI-IDN compatible regex using various Unicode codepoints characteristics.
  - For IDN it would be like a reimplementation of the IDNA protocol tables in regex!
- Given that both sides of an EAI may have UTF8, then one regex for an EAI could be .*@.* which is only verifying the presence of the '@' character.

Jakarta Mail

- Most used Java package to send email; also has a validate() method for email addresses.
- validate() does a good job in validating email addresses, especially the local part:
  - It verifies illegal characters such as: ()<>,;:"[]\ , whitespaces, etc.
  - It verifies the characters are only digit and letters per the definition of Unicode classes.
  - It does not validate IDN, so add IDN validation and preparation as an additional step.

Jakarta Mail Usage

- `import javax.mail`
- Maven:

```
<dependency>
  <groupId>com.sun.mail</groupId>
  <artifactId>jakarta.mail</artifactId>
  <version>1.6.5</version>
</dependency>
```

```
import javax.mail.internet.InternetAddress;
try {
 InternetAddress emailAddr = new InternetAddress(input);
 emailAddr.validate();
} catch (AddressException e) {}
```

Other Libraries

- Apache Commons Validator
  - Has domain and email validators.
  - Do not use as it relies on a static list of TLDs! OUTDATED!
- EmailValidator4J
  - Claims to support EAI! (not tested)
  - https://github.com/egulias/EmailValidator4J

Sending Email

Jakarta Mail Usage for Sending Email

- Same library and Maven as before.

```
Properties properties = System.getProperties();
      properties.setProperty("mail.smtp.host", host);
      Session session = Session.getDefaultInstance(properties);
      try {
        MimeMessage message = new MimeMessage(session);
        message.setFrom(new InternetAddress(from));
        message.addRecipient(Message.RecipientType.TO, new InternetAddress(to));
        message.setSubject("This is the Subject Line!");
        message.setText("This is actual message");
        Transport.send(message);
      } catch (MessagingException e) {
      }
```

Simple Java Mail

- Jakarta Mail wrapper; simpler calls to send emails.
  - Uses (and includes) another library for email validation.
  - Uses various Regex.
  - Considers any UTF8 as invalid, therefore no support for U-label as domain or EAI.
  - Internal validation based on the obsolete RFC2822.

A Real Example

- Dev team realized that the package com.sun.mail:javax.mail:1.5.6 used to send email subscription confirmation via SMTP already had a "validate" function. They rewrote the isEmailValid method:

```
public static boolean isEmailValid(String email) {
  try {
    var iEmail = new javax.mail.internet.InternetAddress(email);
    iEmail.validate();
    return true;
  } catch (AddressException e) {
    return false;
  }
}
```

- However, they found the method is still failing.

A Real Example

- They found this internationalization feature was corrected in a newer version, so they upgraded to: com.sun.mail:jakarta.mail v1.6.5

```
public static boolean isEmailValid(String email) {
  try {
    var iEmail = new javax.mail.internet.InternetAddress(email);
    iEmail.validate();
    return true;
  } catch (AddressException e) {
    return false;
  }
}
```

- Finally, by inspecting these fixes in javamail and its renamed version jakartamail, they realized they needed to also modify the subscribe function and their SMTP server to support a new "SMTPUTF8" flag.

A Real Example

- The company dev team did part of the job. Emails using IDNs will still be rejected by Jakarta Mail.
- Here is the complete example, preparing email address with A-labels in domain, which is then used as input to any libraries/frameworks.
- The local part remains UTF8 which may not be working in the mail delivery path.

```
IDNA validator = IDNA.getUTS46Instance(
    IDNA.NONTRANSITIONAL_TO_ASCII
    | IDNA.NONTRANSITIONAL_TO_UNICODE
    | IDNA.CHECK_BIDI
    | IDNA.CHECK_CONTEXTJ
    | IDNA.CHECK_CONTEXTO
    | IDNA.USE_STD3_RULES);
IDNA.Info info = new IDNA.Info();
String localpart = email.substring(0, email.lastIndexOf("@"));
String domain = email.substring(email.lastIndexOf("@") + 1);
StringBuilder output = new StringBuilder();
validator.nameToASCII(domain, output, info);
email = localpart + "@" + output.toString();

if (isEmailValid(email)) {
  subscribe();
} else {
  throw new Exception("Invalid email address, please review it and submit again");
}
```

Storing Domain Names and Email Addresses

Database Considerations

- SQL, e.g., MySQL, Oracle, Microsoft SQL Server.
  - Set domain names to max: 255 octets, 63 octets per label.
    - In UTF8 native, variable length.
  - Recommendation to use variable length String columns.
  - Consider/verify the object-relational mapping (ORM) driver/tool if you are using one.
- noSQL, e.g., MongoDB, CouchDB, Cassandra, HBase, Redis, Riak, Neo4J.
  - Already UTF8 variable length.

Domain Names and Email Addresses on Android Platform

android.icu.text.IDNA Library

- Same ICU library, integrated into android OS.
  - No need to add packages dependencies.
  - https://developer.android.com/reference/android/icu/text/IDNA
  - Same considerations as discussed before for the ICU4J library.

Conclusion

Prog. Languages Support

UASG018A

LANGUAGE	LIB NAME	COMPLIANCE (%)	Type
Javascript	Idna-Uts46	85.5	IDN
Javascript	Nodemailer	84.3	Mail
Javascript	Validator	94.2	Mail
Python3	Django_Auth	48.1	Mail
Python3	Email_Validator	86.3	Mail
Python3	Encodings_Idna	67.7	IDN
Python3	Idna	100	IDN
Python3	Smtplib	84.3	Mail
Rust	Idna	87.1	IDN
Rust	Lettre	7.8	Mail

LANGUAGE	LIB NAME	COMPLIANCE (%)	Type
C	Libcurl	84.3	Mail
C	Libidn2	95.2	IDN
C#	Mailkit	84.3	Mail
C#	Microsoft	83.9	IDN
Go	Mail	100	Mail
Go	Idna	79	IDN
Go	Smtp	19.6	Mail
Java	Commons-Validator	85.5	Mail, IDN
Java	Guava	77.8	IDN
Java	ICU	93.5	IDN
Java	Jakartamail	82.4	Mail
Java	JRE	71	IDN

Conclusion

- Be aware that UA identifiers may not be fully supported in software and libraries.
- Use the right libraries and frameworks.
- Adapt your code to properly support UA.
- Do unit and system testing using UA test cases to ensure that your software is UA ready.

Get Involved!

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- Join APAC EAI Implementers' Group mailing list for technical support (by THNIC)

- For more information on UA, email info@uasg.tech or UAProgram@icann.org
- Access all UASG documents and presentations at: https://uasg.tech

- Access details of ongoing work from wiki pages: https://community.icann.org/display/TUA
- Register to participate or listen in the UA discussion list at: https://uasg.tech/subscribe
- Register to participate in UA working groups here.

Some Relevant Materials

- See https://uasg.tech for a complete list of reports.
  - Universal Acceptance Quick Guide: UASG005
  - Introduction to Universal Acceptance: UASG007
  - Quick Guide to EAI: UASG014
  - EAI – A Technical Overview: UASG012
  - EAI – Evaluation of Major Email Software and Services: UASG021B
  - Universal Acceptance Readiness Framework: UASG026
  - Considerations for Naming Internationalized Email Mailboxes: UASG028
  - Evaluation of EAI Support in Email Software and Services Report: UASG030

Engage with ICANN – Thank You and Questions

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