

Matching Passenger Names for Air Travel

SITA Lab Proves Reliability of Algorithm Based Name Matching

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Introduction

Today, over 3 billion people travel by air each year, which equates to 8 million each day. During flight check-in for each passenger, airline staff or an airline's computer system is tasked to validate that the passenger has a valid Boarding Pass for that flight and if he or she has matching travel and identification documents such as a Passport.

A unique identifier in the form of a Passport Number or Government ID is often absent from the Boarding Pass as this is not required as part of the flight booking process. Therefore, it is only the names on the Passport and Boarding Pass that are cross checked to see that they match. In most cases, the task of checking to see if the Passport and Boarding Pass names match falls to the Ground Agents who then make the decision as to whether the names are a correct match or not.

The question is ... what happens when the names don't match exactly between the reservation and the Passport or other identification document?

In a recent assessment, this situation occurs for as much as 50% of Asian names, due to a wide variety of issues that will be dealt with in this article. Whilst some airlines will accommodate a near-enough match, other airlines, due to government and/or law enforcement requirements, require an exact match or otherwise risk a passenger no-go or administrative charge.

The number of air passengers is predicted to grow at an average annual rate of between 4.2 and 4.7 percent through to 2033. By 2030, approximately six billion passengers annually will require security and screening at airports around the world.

SITA Lab explored the challenges faced by airlines in manually carrying out names checks and the difficulties in identifying legitimate matches, especially in the case of Asian names.

Accordingly, SITA lab has proposed an automated solution to address this issue using a smart algorithm.

Why is Name Verification a Critical Requirement?

Improved passenger flow, efficiency, accuracy and enhanced security are the major benefits to be gained from an automated name verification system and the global industry factors that are driving this requirement include:

- **Government Regulations:**
Airlines have an obligation to ensure that passengers have proper and matching travel

and identification documents before flying them to another country. Entry Visas, a return flight or other such controls may be required by some governments and fines may be imposed on the airline for breach of regulations.

- **Airline Rules:**

Airlines want to ensure a passenger name and booking name are the same, and deter travel agents from early block booking of tickets. Passenger's names are often the only identifier at the time of booking, and a unique identifier in the form of a Passport Number or Government ID may not be required as part of the initial flight reservation process.

- **Airport Security:**

In the past decade, many governments and airports have increased the level of accuracy required to ensure that the passenger is who he claims to be and to ensure greater control over who goes airside. This restriction requires a passenger to have a Passport as a travel document and the Passport name must match the Boarding Pass name.

- **Self-service Check-in:**

Automated kiosks, online systems and the increasingly popular mobile apps, often validate a booking against a passenger's Passport name. Any minor (and acceptable) differences still require manual agent verification, which diminishes the value and efficiency of having automated systems.

- **Foreign Travel Restrictions:**

In cases of travel restrictions based on war and other situations, some countries and cities may impose temporary measures for airlines to conduct ID checks based on routes and destinations.

An automated name matching process would significantly enhance the ability for airlines and airports to comply with government regulations, improve security and implement more self service solutions that will enhance the experience and streamline the throughput of passengers through the airports and onto the aircraft.

Current Travel Document Compliance Checking

Manual checking of documents by an agent at boarding is a slow repetitive process and prone to human error. Not only has an agent to check names on documents, they also have to check that the passenger looks like their Passport photo and if the Passport is legitimate and not expired.

Airlines have to provide API (Airline Passenger Information) data to governments' relevant border control agencies, usually after aircraft departure. This data comprises the standard information contained in each passenger's Passport which is combined with flight information. Every year, more and more governments are looking for this information.

Some airlines have automated solutions available at a kiosk, bag-drop or even online. The passenger scans their travel document (or enters the data), the document data is combined with the itinerary data and submitted to Timatic AutoCheck. In the vast majority of cases, the check-

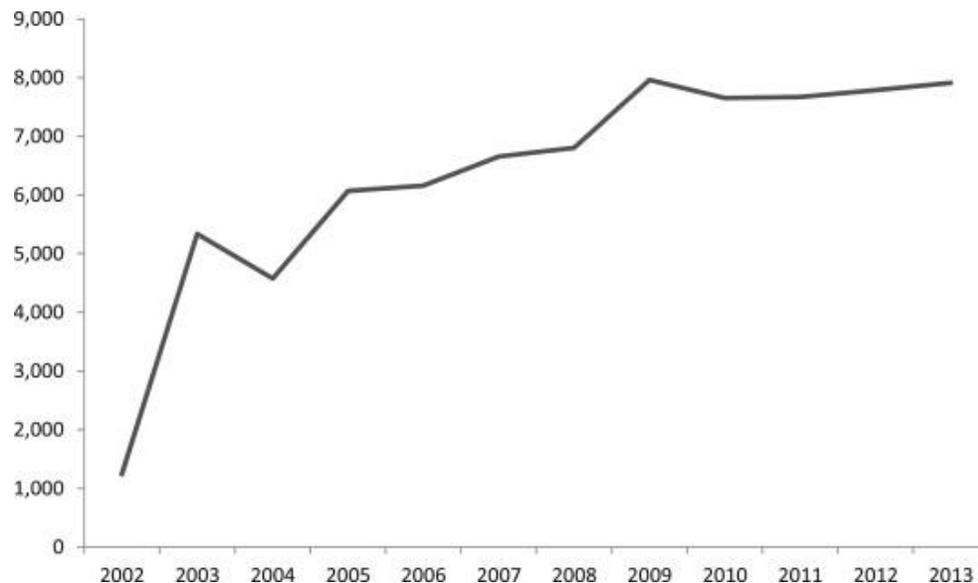
in process is allowed to proceed seamlessly but in some cases there may be an issue with documents and human intervention is still required. This can happen when the Passport and Reservation/Boarding Pass names do not match.

Difficulties occur when passenger enter Passport data incorrectly either unintentionally or for subversive purposes. In some cases, passengers may want to substitute their own details for another if, for example, they are on a watch list.

Another situation where discrepancies occur between names on travel documents is when Landing Cards are required by governments. These cards are currently paper based and filled in manually by the passenger. The information again may be intentionally or mistakenly incorrect.

Currently, the TSA (Transportation Security Administration) operations includes some staff performing name matching manually for input/output US passengers with agents using highlighters. TSA operations budget was US\$7.39 billion for 2014.

Figure 1: Transportation security administration total expenditures; 2002–2013 (\$US millions).



Source: Published budgets of the Department of Homeland Security (2002–2012).

Airlines bear the responsibility for bringing in unauthorized persons into a country and pay heavily for this. The more accurately that an airline can identify a passenger, the lower the risk that they will transport an illegal person, or a person who is a security risk. Additionally, the more automated they can make that process, the more costs they will save.

Challenges with Cultural and Ethnic Naming Practices

There is a wide variety of naming conventions across different countries, cultures and ethnicities. This can impact how names are viewed, interpreted and used, and therefore how they are represented in Passengers’ Passports and Boarding Passes. The following are some of the common observations across the different geographies.

Asian and Middle Eastern names tend to use abbreviations for common name elements as spelling these out in full would overrun the finite limits of the MRZ (Machine Readable Zone) strip found along the bottom of Passports. (Refer to the section *Matching Boarding Pass Names against a Passport Names*

To match passenger names between a boarding pass and passport, we need to understand what constraints and practices exist for passport name standards, in addition to how names are entered into an airline reservation system. on page 5) Some examples of these abbreviations are ‘Mohd’ which is often used as an abbreviation for ‘Mohammad’, ‘Al’ or ‘So’ as ‘Son Of’, ‘Ap’ or ‘Do’ as ‘Daughter Of’.

In addition to the abbreviations, there are varied spellings for the same name. For example, ‘Mohammad’ may be ‘Mohamad’, ‘Mohamed’ or ‘Mohammed’. Airline reservations and the associated Boarding Passes produced from the reservation information may also contain salutations such as ‘Mr’, ‘Ms’, ‘Dr’, ‘Capt’, ‘Professor’ and so on, which may need to be omitted to allow matching against the Passport name.

Figure 2: Examples of commonly seen variances between BCBP and MRZ

Passport Name	Boarding Pass Name	Reason for Variance
SUHARTO	SUHARTO/SUHARTO	BCBP mandates primary and secondary identifiers. A salutation may also be entered instead of a secondary identifier
WANG, XI KER DEREK	WANG/DEREK XI KER	Swapped ethnic and western name within secondary identifier field
ISHAK AL ISMAIL	ISMAIL/ISHAK	Patronymic reference omitted
MOHAMMAD ALI SHARUL	MOHD ALI SHARUL	Common abbreviation
MOHAMAD SHAHRAH BIN ABDUL KARIM	MOHAMAD/SHAHRAH	Partial omission of secondary identifiers
WANG, XI KER	XI KER/WANG	Swap of first/last names
ASUNCION, MARY ANGELICA	ASUNCION/MARYANGELIC	Truncation BCBP limit

Many Indonesians have a single name, and this may appear in the Passport as a single Surname and no Given name, or a single Given name and no Surname in their Passport. This poses a problem for Airline Booking Systems as Given Names and Surnames are required to be present. A common practice is to repeat the Surname or Given name in the empty field. In some cases a salutation (e.g. Mr) may also be entered to take the place of the empty field.

Some ethnicities, such as the Chinese, will always represent their Surname before their family name. As a result, there is a common mistake of using their Surname as their 'First Name', and their Given name as their 'Last Name'. Any paper or online forms using the terms 'First Name', 'Last Name' will often result in these errors. A simple method would be to merely swap the Surname and Given names. However, this is not always appropriate as 'Zhang Bin' (<Surname Givenname>) is a different person from 'Bin Zhang' (<Surname Givenname>), and some conditions may need to be applied.

Some ethnicities such as Malay, Middle Eastern and other indigenous ethnicities may use a Patronymic/Matronymic name structure with no Surname. The name bears reference as a son (Bin) or daughter (Binti) to their father, mother or other ancestor's Given Name (e.g. Shahrul Bin Karim). There are Passport issuing authorities (e.g. Singapore) whose practice is to represent the entire name as multiple identifiers within the Surname field of the MRZ. The passenger name in the airline reservation system may contain the Patronymic/Matronymic reference (i.e. So, Al, Bin, Binti) or sometimes it may be omitted.

Modern Asians may adopt both Dialect and Western names. The Chinese, in particular, often place Western names before their Surname, but their Dialect name after their surname. (e.g., Derek Wang Xi Ker). Hence, a re-order of names in this sequence is commonly practiced. It is not common to place the Dialect name, 'Xi Ker' in this case, before the Surname.

Many names, being a transliteration from a non-English language into Latin characters, may have spelling variations. For example, Müller becomes Mueller, and Gößmann becomes Goessmann. The Russian surname Горбачёв could be transcribed as "Gorbachev", "Gorbatschow", "Gorbachov", "Gorbachov", or "Gorbaczow". Accommodating spelling variations for airline reservation names against the Passport name may be necessary as some passengers tend to adopt a specific name spelling for travel.

Spanish names, which are also found across the Americas, as well as some regions in Europe, Africa and Asia, generally use two surnames. A woman's name may also reference her husband's paternal surname, for example 'Carmen SÁNCHEZ Rubio de García'.

Carmen may be referred to as 'Carmen SÁNCHEZ Rubio', 'Carmen SÁNCHEZ', but never 'Carmen Rubio'.

Matching Boarding Pass Names against a Passport Names

To match passenger names between a boarding pass and passport, we need to understand what constraints and practices exist for passport name standards, in addition to how names are entered into an airline reservation system.

This allows us to apply name manipulation and matching rules taking into consideration how passenger names are being represented in their passports and boarding passes.

1. Conformation to the IATA BCBP standard, Resolution 792.
2. Additional practises imposed by the booking agent/system
3. Both the Primary Identifier and Secondary Identifier are typically required. Passengers with only one identifier name in their passport may have the other identifier filled with a salutation or a repeat of the single identifier. Practices vary by airline / country.
4. Some characters may not be translated correctly due to host system limitations.
5. Truncation due to character limitation may occur.

Figure 6: Boarding Pass Name Example

BP Name	KWEK/SHIH MIN JONATHAN PAUL or, KWEK/SHIHMINJONATHANPAUL
Primary Identifier	KWEK
Identifier Separation	/
Primary Identifier	KWEK
Secondary Identifier	SHIH MIN JONATHAN PAUL or SHIHMINJONATHANPAUL

It is common practice for space separators to be omitted from the Boarding Pass name. This makes it very difficult to identify separate name words for validation.

Proof of Concept

Identifying acceptable differences between passenger boarding pass and passport names is a task that SITA Lab set out to resolve.

The Lab’s Proof of Concept (POC) trial showed that up to 50% of names did not have precise matches at an Asian airport, while 25% did not match at a Middle East airport trial.

The trial also proved that the algorithm-based name matching solution far exceeded the performance of eye-ball comparison of names and also eliminated errors due to human fatigue from repetitive data comparison.

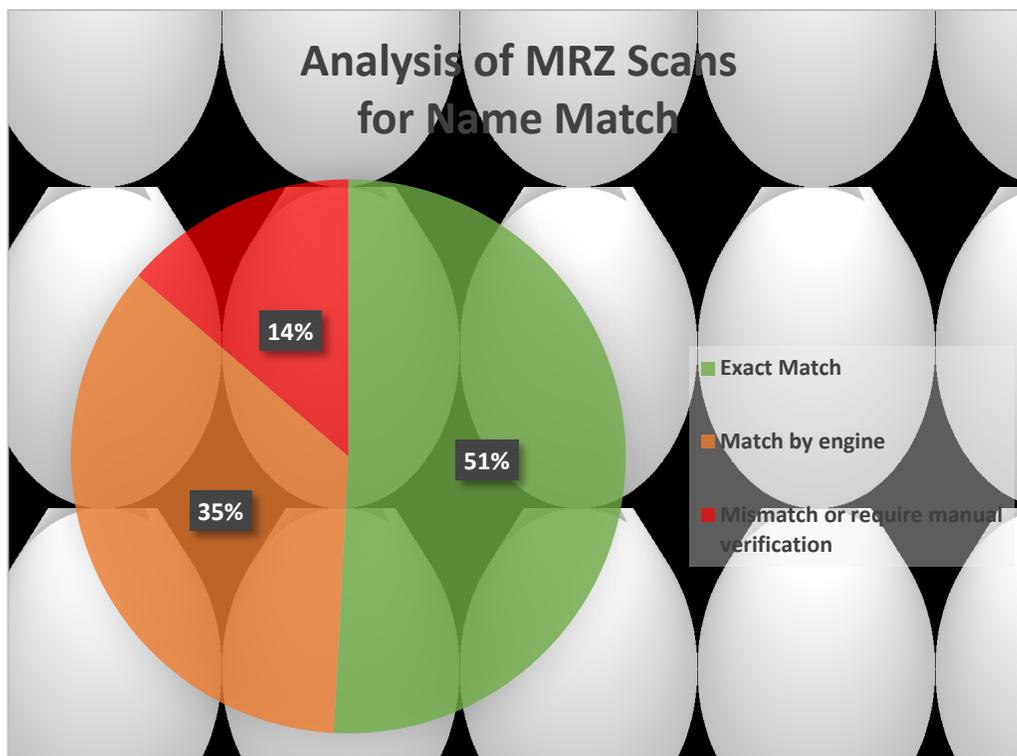
It quickly become obvious that the business need, whether this is for Government regulation, booking enforcement, or facilitation of check-in, will determine what type of algorithms and rule sets should be used.

In this particular trial, the primary focus was enforcement of name matches, as opposed to permitting fuzzy matching. Hence, the usual off-the-shelf algorithms such as NYSIIS, LIG2 and Phonetic algorithms could not be applied.

In a sample of 870 passenger name transactions, the following results were obtained:

- 51% names matched exactly
- 35% of boarding pass names contained differences that could be determined to be the same person
- 14% of boarding pass names differed too much for the current algorithm to match automatically, and required ground agent verification (these are desired to be flagged up for the POC's enforcement use case)

Figure 7: Results for Initial Proof of Concept



The trial utilised highly stringent rules to be overly conservative, and while a fairly large percentage (14%) was referred for manual verification, the results showed that there were no false matches. The actual mismatch was less than 1% (4 of 870 names).

SITA Lab Approach to Matching Passport and Boarding Pass Names

For the POC, SITA Lab developed an algorithm based name matching solution to address the issue of name matching between Passport and Boarding Pass names.

For this solution, the preferred approach is to manipulate the Passport name, unless a specific operation on the Boarding Pass name is desired, and it applies a suite of algorithms and to both name sources.

The following process is used to determine name matches as accurately as possible:

1. Separate Passport name into Primary and Secondary Identifiers, and parse according to separator as shown:

P1[<P2][<P3]..[<Pn]<<[S1][<S2][<S3]..[<Sn].

Separate Boarding Pass name into Primary and Secondary Identifier, and parse according to separator, removing any whitespace:

P/S

2. Apply a Pre-Match Rule Set to Boarding Pass and Passport names
3. Apply a Main Rule Set to the Passport name only.
4. Compare the Passport name with the Boarding Pass name.

Matching Rules

These rules are applied to both the Boarding Pass and Passport Names

Sets of rules were formulated with reference to how a ground agent would compare the BP and MRZ names, and how they would make a decision on whether the two names refer to two different people, or to the same person. In practice, human errors are made occasionally but through the application of a set of rules (the name match algorithm) these mistakes could be minimised.

An exercise was performed for Asian passenger names as a reference, but many of the concepts could be applied to similar situations in other parts of the world such as the Middle East or Slavic countries.

Pre Matching Rules

<p>Identify Names</p> <p>Separate MRZ names, which are delimited by the ‘<’ separator, into multiple Primary and Secondary Identifiers.</p> <p><i>MRZ Example:</i></p> <p>KWEK<<SHIH<MIN<JONATHAN</p> <p>is separated into:</p> <p>P1=KWEK S1=SHIH S2=MIN S3=JONATHAN</p> <p>Whitespace is removed from Boarding Pass name.</p> <p><i>BP Example:</i></p> <p>KWEK/JONATHAN SHIH MIN</p> <p>With whitespace removed:</p> <p>P=KWEK S=JONATHANSHIHMIN</p>	<p>P1P2P3P4S1S2S3S4</p>
<p>Remove Special Characters</p> <p>For BP and MRZ names, remove special characters and numbers and convert to upper case.</p> <p><i>Example:</i></p> <p>A'Isyah becomes AISYAH</p>	<p>'-1234567890V()</p>

Ignore Salutations in BP Primary Name

The rule to ignore items in the salutation list shown is applied to MRZ and BP Primary names.

Malay, Indian, Middle Eastern names often include a parent's name within the Primary Identifier. The MRZ often does not have any Secondary Identifier. This rule is not applied to the Secondary Identifier to reduce false matches.

Example:

Accept the following matches

MRZ	BP
BINTE<ISMAIL<ISHAK	BINTE ISMAIL/ISHAK
BINTE<ISMAIL<ISHAK	ISMAIL/ISHAK

- PROFESSOR
- REVEREND
- CAPTAIN
- MASTER
- DOCTOR
- TANSRI
- DATIN
- DATUN
- DATOK
- PROF
- CAPT
- MISS
- MSTR
- MRS
- REV
- CHD
- INF
- SO (Son Of; Indian)
- DO (Daughter Of; Indian)
- AP (Daughter Of; Middle East)
- AL (Son Of; Middle East?)
- MR
- MS
- DR

Ignore Salutations in BP Secondary

Similar to the previous implementation for BP Primary Name, but applied to MRZ and BP Secondary names.

PROFESSOR
REVEREND
CAPTAIN
MASTER
DOCTOR
TANSRI
DATIN
DATUN
DATOK
PROF
CAPT
MISS
MSTR
MRS
REV
CHD
INF
MR
MS
DR

Main Matching Rules

These rules are applied to Passport names only

<p>Swap Primary / Secondary Names</p> <p>Chinese names often wrongly use Surname as the first name, and Given names as last name. Allow the Primary / Secondary Name to be swapped.</p> <p>This rule may be overly flexible, and the next rule may be used as a more conservative alternative.</p> <p><i>Example:</i></p> <p>Accept the following match</p> <table border="0"> <tr> <td>MRZ</td> <td>BP</td> </tr> <tr> <td>KWEK<<SHIH<MIN</td> <td>SHIH MIN/KWEK</td> </tr> </table>	MRZ	BP	KWEK<<SHIH<MIN	SHIH MIN/KWEK	<p>S1S2S3S4 P1P2P3P4</p>				
MRZ	BP								
KWEK<<SHIH<MIN	SHIH MIN/KWEK								
<p>Swap Primary / Secondary Names if > 2 Identifiers</p> <p>Conservative application of the above rule, but only used when more than 2 identifiers (1P, 2S) are present. This may be used if there is a need to minimise false positive matches.</p> <p><i>Example:</i></p> <p>Accept the following match</p> <table border="0"> <tr> <td>MRZ</td> <td>BP</td> </tr> <tr> <td>KWEK<<SHIH<MIN</td> <td>SHIH MIN/KWEK</td> </tr> </table> <p>Reject the following match</p> <table border="0"> <tr> <td>MRZ</td> <td>BP</td> </tr> <tr> <td>XIAO<<MI</td> <td>MI/XIAO</td> </tr> </table>	MRZ	BP	KWEK<<SHIH<MIN	SHIH MIN/KWEK	MRZ	BP	XIAO<<MI	MI/XIAO	<p>S1S2S3S4 P1P2P3P4</p>
MRZ	BP								
KWEK<<SHIH<MIN	SHIH MIN/KWEK								
MRZ	BP								
XIAO<<MI	MI/XIAO								

<p>Shift Order of Names (Secondary Names)</p> <p>Cycle Shift Right for Secondary name only.</p> <p>Permit use of Chinese name before Western name.</p> <p><i>Example:</i></p> <p>Accept the following matches</p> <table border="0"> <tr> <td>MRZ</td> <td>BP</td> </tr> <tr> <td>KWEK<<SHIH<MIN<JONATHAN<PAUL</td> <td>KWEK/JONATHAN PAUL SHIH MIN</td> </tr> <tr> <td>KWEK<<SHIH<MIN<JONATHAN<PAUL</td> <td>KWEK/ PAUL SHIH MIN JONATHAN</td> </tr> </table> <p>Reject the following match</p> <table border="0"> <tr> <td>MRZ</td> <td>BP</td> </tr> <tr> <td>KWEK<<SHIH<MIN<JONATHAN<PAUL</td> <td>KWEK/PAUL JONATHAN SHIH MIN</td> </tr> </table>	MRZ	BP	KWEK<<SHIH<MIN<JONATHAN<PAUL	KWEK/JONATHAN PAUL SHIH MIN	KWEK<<SHIH<MIN<JONATHAN<PAUL	KWEK/ PAUL SHIH MIN JONATHAN	MRZ	BP	KWEK<<SHIH<MIN<JONATHAN<PAUL	KWEK/PAUL JONATHAN SHIH MIN	<p>P1P2P3P4 S4S1S2S3</p> <p>P1P2P3P4 S3S4S1S2</p> <p>P1P2P3P4 S2S3S4S1</p>
MRZ	BP										
KWEK<<SHIH<MIN<JONATHAN<PAUL	KWEK/JONATHAN PAUL SHIH MIN										
KWEK<<SHIH<MIN<JONATHAN<PAUL	KWEK/ PAUL SHIH MIN JONATHAN										
MRZ	BP										
KWEK<<SHIH<MIN<JONATHAN<PAUL	KWEK/PAUL JONATHAN SHIH MIN										
<p>Ignore Salutations in MRZ Primary</p> <p>Ignore salutations for MRZ Primary</p>	<p>See salutations list above</p>										
<p>Ignore Salutations in MRZ Secondary</p> <p>Ignore salutations for MRZ Secondary</p>	<p>See salutations list above</p>										
<p>Repeat Primary Name</p> <p>Where the MRZ has only one Primary Identifier and no Secondary Identifiers, accept a BP name with a repeat of the Primary Identifier again (common for Indonesian names). Some airlines may use NFN in placed of the Secondary Identifier to denote 'No First Name'.</p> <p><i>Example:</i></p> <p>Accept the following match</p> <table border="0"> <tr> <td>MRZ</td> <td>BP</td> </tr> <tr> <td>SUHARTO</td> <td>SUHARTO/SUHARTO</td> </tr> </table>	MRZ	BP	SUHARTO	SUHARTO/SUHARTO	<p>P1P1</p>						
MRZ	BP										
SUHARTO	SUHARTO/SUHARTO										

<p>Repeat Secondary Name</p> <p>Where the MRZ name has only one Secondary Identifier and no Primary Identifiers, accept a BP name with a repeat of the Secondary Identifier again (common in Indonesia, Mongolia, southern India). Some airlines may use NLN in placed of the Secondary Identifier to denote 'No Last Name'.</p> <p><i>Example:</i></p> <p>Accept the following match</p> <table border="0"> <tr> <td>MRZ</td> <td>BP</td> </tr> <tr> <td>SUHARTO</td> <td>SUHARTO/SUHARTO</td> </tr> </table>	MRZ	BP	SUHARTO	SUHARTO/SUHARTO	<p>S1S1</p>
MRZ	BP				
SUHARTO	SUHARTO/SUHARTO				
<p>Split double primary Passport names into two single primary Passport names</p> <p>Treat hyphen in Primary Name as separate name.</p> <p><i>Example:</i></p> <p>Accept the following match</p> <table border="0"> <tr> <td>MRZ</td> <td>BP</td> </tr> <tr> <td>SIMPSON<SMYTHE<<JOHN</td> <td>SIMPSON-SMYTHE/JOHN</td> </tr> </table>	MRZ	BP	SIMPSON<SMYTHE<<JOHN	SIMPSON-SMYTHE/JOHN	
MRZ	BP				
SIMPSON<SMYTHE<<JOHN	SIMPSON-SMYTHE/JOHN				

Post Matching Rules

<p>Remove Whitespace from MRZ name</p> <p>Accept the following match</p> <table border="0"> <tr> <td>MRZ</td> <td>BP</td> </tr> <tr> <td>KWEK<<SHIH<MIN</td> <td>KWEK/SHIHMIN</td> </tr> </table>	MRZ	BP	KWEK<<SHIH<MIN	KWEK/SHIHMIN	
MRZ	BP				
KWEK<<SHIH<MIN	KWEK/SHIHMIN				
<p>Truncation due to BP limit</p> <p>Truncation of MRZ name to match a truncated Boarding Pass name</p> <table border="0"> <tr> <td>MRZ</td> <td>BP</td> </tr> <tr> <td>KWEK<<SHIH<MIN<PAUL<JONATHAN</td> <td>KWEK/SHIHMINPAULJONA</td> </tr> </table>	MRZ	BP	KWEK<<SHIH<MIN<PAUL<JONATHAN	KWEK/SHIHMINPAULJONA	<p>According to configured boarding pass limit number of characters.</p>
MRZ	BP				
KWEK<<SHIH<MIN<PAUL<JONATHAN	KWEK/SHIHMINPAULJONA				

Review of Matching Capability

Algorithm based name matching is very fast, far exceeding the performance of eye-ball comparison of names. Algorithm based matching also eliminates errors due to human fatigue from repetitive data comparison.

While this POC was targeted at Middle Eastern and Asian passengers, the rule sets can be adapted for South American, Schengen and other ethnicities.

There are limitations as to the name differences that can be processed using any name matching algorithm. It may be impossible to match some names due to a lack of unique indicators in the names or the omission of sections of the name that would make matching highly inaccurate. In these cases, the mismatches would have to be dealt with by exception handling, most likely by reverting to human intervention to confirm or deny the match, often requiring additional forms of identification.

The relatively small number of rules used in the SITA Lab Name Matching POC already demonstrates its capability to identify acceptable differences between passenger BP and MRZ names. As matching logs and statistics are accumulated, more sophisticated rules can be further developed to improve machine capability for handling BP and MRZ name matching.

Conclusion

The travel industry currently lacks standards for handling discrepancies between passenger travel documents and boarding passes. Today, we see different policies and practices across different border control agencies and airlines. This poses problems for many aspects of travel – compliance for regulations & security, preventing misuse, and enabling self-service systems to function effectively.

The findings from the Proof of Concept indicate that the name matching algorithm is highly beneficial for comparing passenger names, particularly in the absence of, or used in conjunction with a national identifier such as a Passport number or government issued ID.

The name matching algorithm can be used for improving name matching success rates for a number of airline and travel operations including:

- Self-service check-in systems, such as automated kiosks, airline web pages, mobile apps, etc.
- Immigration and border controls
- Other manual passenger information checks

The automated algorithm based name matching solution can help to better serve the travel industry - significantly reducing human error due to fatigue from repetitive manual information checking and offers a promising way to improve the effectiveness and efficiency of passenger flow for the Air Transport Industry.

Figure 8: Name matching could be applied to mobile, online, kiosks or even agent checks



References:

1. David Hey (2006). *Family Names and Family History*, pp.92-93. ISBN 1852855509.
2. *A Comparison and Analysis of Name Matching Algorithms* - <http://waset.org/publications/8664/a-comparison-and-analysis-of-name-matching-algorithms>
3. *Patronymic names* - <https://en.wikipedia.org/wiki/Patronymic>
4. ICAO (International Civil Aviation Authority) Document 9303 specifications for Machine Readable Travel Documents (MRTD) <http://www.icao.int/Security/mrtd/pages/Document9303.aspx>
5. IATA Bar-Coded Boarding Passes (BCBP) <http://www.iata.org/whatwedo/stb/bcbp/pages/index.aspx>
6. TSA Passenger Identification <https://www.tsa.gov/travel/security-screening/identification>
7. TSA overview https://en.wikipedia.org/wiki/Transportation_Security_Administration
8. European Council PRADO - Public Register of Authentic travel and identity Documents Online <http://www.consilium.europa.eu/prado/en/prado-start-page.html>
9. *Journal of Air Transport Management*, Volume 48, September 2015: Aviation security: Costing, pricing, finance and performance. David Gillena, William G. Morrisonb. <http://dx.doi.org/10.1016/j.jairtraman.2014.12.005>
10. *Names and Surnames among Malays* <http://www.sailanmuslim.com/news/wp-content/uploads/names-and-surnames-among-the-malays.pdf>