Aeronautical Information Bulletins: METARs and NOTAMs
HG2052 Assignment 1

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Overview

Modern civil aviation achieves smooth and safe flights by accurately and efficiently relaying highly time-sensitive information across vast geographical distances between multiple individuals from different cultural and linguistic backgrounds. Such impressive coordination relies on processes of linguistic significance. For instance, Howard (2008) and Jones (2003) both describe linguistic obstacles faced during *spoken* information transmission, in the medium of pilot-air traffic control communications. This paper seeks to similarly describe the medium of *written* aviation information transmission from a linguistic perspective, by examining two particular types of written flight information bulletins, Meteorological Terminal Aviation Routine Weather Reports (METARs) and Notices to Airmen (NOTAMs), both of which are relied upon every single day by every single civil aviation flight in the world, numbering almost 37 million in 2018 (World Bank, 2019). An examination of these bulletins reveals that several characteristics of computer-mediated communication combine with features more commonly found in formal written discourse to create final products that can be argued to be rather linguistically unique. A description of each of these types of flight information bulletins follows, focusing on their salient linguistic features rather than the specialised technical details.

METARs

Meteorological Terminal Aviation Routine Weather Reports (METARs) are abbreviated texts issued at regular intervals to convey to pilots the latest surface weather at their destination airports (Federal Aviation Administration, 2016). **Fig 1** below provides an example METAR.

WSSS 030530Z 03010KT 320V090 9999 SCT020 SCT300 31/22 Q1013 NOSIG

Fig 1. Example of a METAR for Singapore Changi Airport. Taken from https://en.allmetsat.com/metar-taf/singapore.php?icao=WSSS

Clearly, without specialised knowledge, such a piece of written discourse would be quite indecipherable to the layman. In fact, a large amount of information has been compressed efficiently into this highly abbreviated 65-character alphanumeric message, awaiting decoding by its recipients. **Fig 2** below decodes the same METAR.

WSSS	The 4-letter International Civil Aviation Organisation (ICAO) airport code for Singapore Changi Airport.
030530Z	Timestamp, providing the day of the month (3rd) and time in Universal Coordinated Time, also known as Zulu time. [Note that the month and year are omitted.]
03010KT	Wind direction from the Northeast (30 degrees on the compass) at speed of 10 knots.
320V090	Wind direction varies between 320 degrees and 90 degrees on the compass.
9999	Visibility in excess of 10,000m (10km).
SCT020	Scattered clouds at 2,000 feet altitude.
SCT300	Scattered clouds at 30,000 feet altitude.
31/22	Temperature is 31 degrees Celsius and dew point is 22 degrees Celsius.

Q1013	Atmospheric pressure for altimeter setting (known as QNH) is 1013hPa.
NOSIG	No significant change to these conditions is expected.

Fig 2. Explanation of the abbreviations in the previously given METAR for Singapore Changi Airport. The full decoding can be found at sources such as Federal Aviation Administration (2016) and National Oceanic and Atmospheric Administration (2008).

Several salient linguistic observations are evident from the example METAR in **Figs 1** and **2**. First, the space-sensitive and time-sensitive nature of the information is foregrounded with the airport code and timestamp respectively. Since METARs are issued at regular intervals, there is no need for less sensitive information such as the month and year to be included (whereas the day might be of importance to flights that are crossing the International Date Line). Secondly, there is heavy use of abbreviations and initialisms with the elimination of all function words, closed class words and conjunctions. This both achieves very high levels of brevity and removes ambiguity, creating a highly codified and standardised format that few other mediums of information transmission can match in terms of efficiency. Additionally, such a format is also conveniently receptive to machine decoding, as the different weather elements (cloud, temperature, wind, pressure, visibility and so on) are not only abbreviated in an individually unique manner, but arrive in a standardised sequence that a computer program can easily master.

NOTAMs

Notices to Airmen (NOTAMs) are informational advisories filed by airports to transmit safety-critical, time-sensitive updates to pilots regarding any change in conditions, procedures or hazards at that particular airport. Compared to METARs which strictly provide meteorological information and are updated regularly, the scope of NOTAMs is broader and the information they provide may have a longer validity of weeks to months, albeit still being temporary in nature (Federal Aviation Administration, 2016). Accordingly, the format of NOTAMs is somewhat more complex.

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A5313/19 NOTAMR A2561/19
Q) WSJC/QMAXX/IV/NBO/A/000/999/0122N10359E005
A) WSSS
B) 1912270751
C) 2003261600
E) TYP B748 CAN ONLY DEPART FM TWY E2 ON RWY 20C DUE TO JETBLAST
AFFECTING THE WORKSITE AT THE NORTHERN END. ALTERNATIVELY, TYP B748
TO DEPART FM RWY 20R.
```

Fig 3. Example of a NOTAM for Singapore Changi Airport. Taken from https://notams.aim.faa.gov/notamSearch/

As can be seen, the format of a NOTAM goes beyond the single-line approach of a METAR. Strikingly, the message is clearly segmented into several letter-coded lines which obey a strict sequence, as follows (see, for example, European Aviation Safety Agency (2016) for the full format and coding):

- The ‘Q’ line provides basic information about the NOTAM, in a precise format that machines are able to decode, but which does not have much meaning to untrained human readers

- The ‘A’ line gives the 4-letter ICAO code for the airport to which the NOTAM applies
- The ‘B’ line contains the start date and time (the format is YYMMDDTTTT)
- The ‘C’ line contains the end date and time (the format is YYMMDDTTTT). Collectively, the ‘A’, ‘B’ and ‘C’ lines foreground the time-sensitive and geographically sensitive nature of the information which follow.
- The ‘E’ line is the main body of the message. Although many words are abbreviated in a standardised manner, a significant number may not be. Comparing this to a METAR, one observes that punctuation and closed-class function words are present in this format.
- Occasionally, a ‘D’ line may appear if the information in the NOTAM only applies for a certain period of time e.g. several hours each day. ‘F’ and ‘G’ lines may also appear to indicate the upper and lower limit height restrictions of the NOTAM. **Fig 3A** shows a more complicated example including these three lines.

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H0331/20 NOTAMN
Q) EGTT/QWYLW/IV/M/AW/000/021/5130N00006W001
A) EGLL B) 2003141400 C) 2003251600
D) MAR 14 1400-1600 1800-2000, 16-18 1400-1600, 19 1400-1600 1900-2100, 20 1400-1600, 21
1400-1600 1800-2000, 23 1600-1800, 24 1400-1600 1900-2100, 25 1400-1600
E) PILOTS ARE REQUESTED NOT TO OVERFLY FILMING WI 1NM RADIUS 513029N
0000549W (GLOBE THEATRE, SOUTHBANK, CENTRAL LONDON). FOR INFO 02079
021466. 2020-02-0003/AS7
F) SFC G) 2100FT AMSL
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Fig 3A. Example of a rather more complicated NOTAM for London Heathrow Airport. Taken from https://notams.aim.faa.gov/notamSearch/

Historical Basis

At this point, it is evident that both METARs and NOTAMs are essentially alphanumeric character strings, with an emphasis on brevity in message composition, and no upper/lowercase distinction. This peculiar format has its basis in how such messages were historically transmitted between airports – using teletype systems, which were the original infrastructure that formed the backbone of the Aeronautical Fixed Telecommunication Network (AFTN). Teletype links allowed teleprinters to transmit such alphanumeric messages along electric circuits (Keith, 1997), using a code as shown in **Fig 4**.

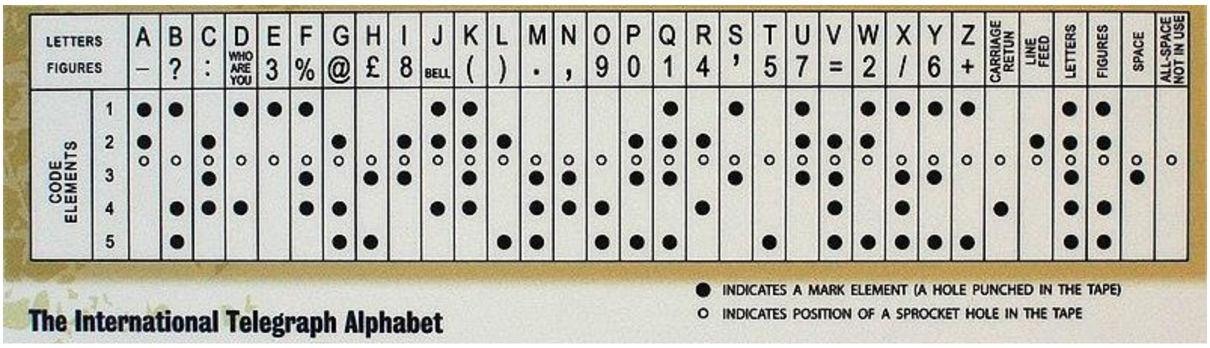

Fig 4. The International Telegraph Alphabet 2 (ITA-2). Retrieved from https://commons.wikimedia.org/wiki/File:International_Telegraph_Alphabet_2_brightened.jpg

With an additional 'Figures' key much like the SHIFT key on a modern keyboard to allow special characters like numerals and punctuation to be transmitted, this 6-bit code was in fact the immediate historical predecessor to the much more commonly known 7-bit American Standard Code for Information Interchange (ASCII) (Smith, 2001). For clarity, **Table 4A** below represents the ITA-2 in binary for letters K to O and their 'Figures' counterparts.

K	011110	**(**	111110
L	001001	**)**	101001
M	000111	**.**	100111
N	000110	**,**	100110
O	000011	**9**	100011

Table 4A. Demonstration of the ITA-2 converted to binary, using the first bit as the 'Figures' key.

In the modern context, teleprinters have been replaced by much more advanced software technology such as Air Traffic Services Message Handling Systems (AMHS) (see, for example, Frequentis Comsoft (n.d.)). However, the historical influence of the electronic medium in which aeronautical information messages were originally sent is crucial in helping us understand the linguistic characteristics of these messages, since **although the modality through which they are transmitted has advanced, their format has remained the same**.

Applying Susan Herring's model

Herring (2007)'s faceted classification scheme for discourse transmitted via technological means is extremely useful to us. In particular, the relevant design features of the electronic medium that constrain the transmission of such aeronautical information messages are its **technological facets**, several of which follow.

Synchronicity

It is crucial to note that aeronautical information messages transmitted along teletype links are received in real time as continuous openings and closings of the electronic circuit. This unique feature makes it similar to speech and other mediums such as Semaphore and Morse, and dissimilar from most written communication which is finished and proofread in its entirety before being transmitted as a single unit. However, modern transmission technology has now allowed such messages to be transmitted in their entirety at once.

Granularity

When the message was transmitted character by character, the basic unit was the character. However, in its modern format especially for NOTAMs, it might be more appropriate to consider the basic unit as the message.

Persistence of Transcript

Once received, a printout could be generated, allowing the transmission to be retrievable. However, as the information contained is often time-sensitive, the utility of having a physical copy extended more to the teletype operator being able to relay it to third parties without loss or error, rather than for the transmission to be preserved permanently for future long-term reference (as is the case for most written discourse). In the modern post-teletype context, all the transmissions are of course retrievable from online databases where they are stored electronically.

Length

Although there is no prescribed maximum number of characters, the time required to transmit such alphanumeric messages via teletype systems placed an upper limit on how long such messages could be. Furthermore, transmission once commenced had to continue until the message ended to avoid the scenario of the receiving party assuming erroneously that the message was truncated and proceeding to begin transmitting another message of his own. This precluded the possibility of taking breaks in the midst of a transmission and imposed a tendency towards shorter, more heavily abbreviated concise messages.

However, with advances in transmission technology away from teletype, it is conceivable that the upper limit on length has significantly increased, since messages are now typed and transmitted as an entire unit. Thus, a reduced reliance on abbreviation could be expected, as seen in some NOTAMs of a more descriptive nature, such as that in **Fig 3**, where entire clauses may be unabbreviated. Nevertheless, abbreviations still reduce overall message length, a tremendously significant benefit considering the sheer volume of such messages that must be transmitted, stored and read by users. Such abbreviations fall into several broad categories as follows:

- Commonly occurring lexical items from the lexical fields of aviation (*taxiway* as TWY, *runway* as RWY, *aircraft* as ACFT), measurement units (*knots* as KT) and weather (*scattered* as SCT, *intermittent* as INTMT).

  For the second category, it is noteworthy that not all units are included consistently, with units such as degrees for bearing, degrees Celsius, feet, metres, and even hectopascals omitted, suggesting that units are included only when it is impossible to tell from the numerical quantity alone which unit is used (for example, of the two possible units for air pressure, mmHg and hPa, a quantity of around 750 would imply the former and 1000 would imply the latter). The problem of units is of significance for two reasons: metric units are not used consistently worldwide, a notable exception being in North America; and aeronautical conventions also use a significant number of non-metric units (such as knots for wind and feet for altitude).

  For the third category, one observes that with the exception of cloud cover which must be expressed adjectivally (*few*, *broken*, *scattered*), most essential weather information (such as wind speed and direction, temperature and air pressure) can be presented by numerical quantities alone. The situation only gets more complicated for specific weather conditions (*snow* as SN, *volcanic ash* as VA, *freezing fog* as FZFG).

  A few open-class words are also abbreviated, such as zero-derived adjectives (*closed* as CLSD, *cancelled* as CNL).
- Closed-class function words such as conjunctions and prepositions (*from* as FM, *between* as BTN, *within* as WI). Interestingly, the ampersand (&) is not used to abbreviate *and*, which remains as AND, despite the considerable space and time savings that could result. This is likely due to historical reasons – an inspection of **Fig 4** reveals that the ampersand is not included in the ITA-2.
- Formulaic, standardised multiword expressions (*caution advised* as CTN ADZ, *no significant change expected* as NOSIG, *due to works in progress* as DUE WIP). Their abbreviation results in remarkable space savings.
- Initialisms (*Federal Aviation Administration* as FAA) and ICAO 4-letter airport codes.

Communication Channel

The message is entirely alphanumeric written text in nature, with no other modalities such as audio or video involved. This has remained the same even with advancement in transmission technology.

Message Format

The order in which information is presented, and the abbreviations and initialisms used, are heavily standardised and codified by the ICAO, to both minimise misinterpretation especially across linguistic and geographical barriers, and allow for ease of machine decoding.

Of the **social facets**, the more relevant ones are as follows.

Participant profile

In addition to human participants, machines i.e. computer programs can also be construed as 'participants' responsible for decoding such messages and displaying the information in an easily readable manner[1]. It follows that such messages must be worded with such machines in mind, as is indeed the case since they obey a standardised format. In the case of METARs, machines can even be entirely responsible for *generating* the message using automated weather data from sensors (this is indicated by AUTO).

Participation structure

In its original form over teletype, this was a 1-to-1 communication, rather than a multiway conversation or a 1-to-many discourse. Sender and recipient were clearly specified and defined with geographical rather than personal identities. However, in the modern era, since such messages are now publicly available online, available to all upon release, such communications have assumed a more 1-to-many character.

Purpose

Clearly, the sole purpose of such communication is the timely, efficient and accurate transmission of information. No solidarity is required or involved, and operators are in all probability complete strangers. This suggests that the discourse would conform more to Bernstein (1971)'s **Elaborated Code**, which is used to convey facts and arises when there is a gap or boundary between speakers, and is characterised most prominently by a more formally correct syntax governed by expected conventions.

Features of Speech and Writing

An examination of the features of such aeronautical information bulletins reveals that the several aforementioned observable characteristics of computer-mediated communication, particularly the extensive use of abbreviation and capitalisation, the use of coordination rather than subordination and the retrievability of the discourse, combine with features more commonly found in formal written discourse, particularly the lack of spontaneity, the need to eliminate error and the objective to convey information, to create final products that can be argued to be rather linguistically unique. **Table 5** lays out 8 major differences between speech and writing, suggesting that such bulletins can overall be considered a specialised type of written discourse.

[1] For example, see https://en.allmetsat.com/metar-taf/singapore.php?icao=WSSS (displays in table form) and https://www.aviationweather.gov/metar (displays as symbols overlaid on map)

	Features typical of				
	Speech	**Writing**	**Speech**	**Writing**	
1	2-way	1-way	Spontaneous	Prepared	**5**
2	Qualitative	Quantitative	Vague	Precise	**6**
3	Adding	Linking	Perceived	Presented	**7**
4	Ephemeral	Permanent	Organic	Perfect	**8**

Table 5. Summary of 8 differences between prototypical speech and writing (original classification, modified from Crystal (2006)), with descriptors most applicable to METARs and NOTAMs highlighted.

These 8 descriptors shall be elaborated in turn. They are presented alongside the closest corresponding descriptors from Crystal (2006)'s model, which are in [grey].

(1) *1-way, not 2-way*

Prototypical speech is a 2-way conversation, while prototypical written discourse is first composed and then read, with no feedback from reader to writer. Aeronautical information bulletins are closer to the latter, except that as previously discussed, their nature has advanced from a 1-to-1 (airport-to-airport) directionality to a 1-to-many transmission (note that speech and writing can of course both be 1-to-many).

(2) *Quantitative, not Qualitative* [factually communicative, not socially interactive]

Such bulletins are used to convey factual rather than social information. However, the modality used is limited to alphanumeric text, rather than more complex means such as the tables, graphs, charts, illustrations or images often employed in prototypical written discourse.

(3) *Adding, not Linking* [loosely structured, not elaborately structured]

Written discourse uses subordination and linking strategies including embedded/subordinated clauses, subheadings, syntactic hierarchies, anaphoric/cataphoric referencing and antecedents to add additional information. METARs, however, use the coordination pattern more typical of spoken discourse, in which additional information is simply added on to the end of an utterance leading to run-on sentences which are often ungrammatical. Here, coordinating conjunctions are absent and such additional information must be added in a strict sequence at the end (often with an explicit signpost, such as RMK for *remark*). For NOTAMs, the main body of the message may display some subordination and prototypical sentence structures, but the overall tendency remains in favour of simple clauses and structures like lists which can be read linearly (in one direction), rather than complex ones with many linkages back and forth.

(4) *Permanent, not Ephemeral* [space-bound, not time-bound]

Messages are retrievable as many times as required by the reader once transmitted.

(5) *Prepared, not Spontaneous* [contrived, not spontaneous]

Messages are carefully and deliberately prepared to be compact, clear and error-free before transmission even begins. In other words, messages are not spontaneous.

(6) *Precise, not Vague* [visually decontextualized, not face-to-face]

Messages must overcome a time lag and face multiple readers with no personal connections to the sender. There is therefore no assumed knowledge, and a need to eliminate ambiguity and the possibility of multiple interpretations, both of which would have dire consequences for flight safety. In contrast, prototypical spoken discourse makes use of paralinguistic cues, deictic expressions and shared conversational setting and context to achieve speed at the expense of precision. It takes place without a time lag and interlocutors often have personal connections.

(7) *Presented, not Perceived* [graphically rich, not prosodically rich]
Messages are visually rather than auditorily decoded. Line breaks are used in the case of NOTAMs, but little punctuation is used. In contrast, auditory spoken discourse makes use of gestures and prosody such as pitch, intonation and volume to convey meaning such as emphasis.
(8) *Perfect, not Organic* [repeatedly revisable, not immediately revisable]
The message is a finished product with elimination of errors and a clear, controlled purpose. Once issued, it can no longer be revised (if an error is made, another NOTAM/METAR has to be issued to correct it). In contrast, spoken discourse is a dynamic, organic product inherently containing error features such as interruptions, overlaps, corrections and repetitions, due to speed, spontaneity and conversational variables such as audience competition and turn-taking.

Conclusions

Examining the linguistic features of aeronautical information bulletins such as METARs and NOTAMs overall suggests that they can be considered a specialised type of written discourse. However, they also display some characteristics more typical of spoken discourse and computer-mediated communication, which can be attributed to the constraints imposed by the electronic medium through which they were historically transmitted, namely teletype systems. Employing Herring (2007)'s tremendously useful faceted classification scheme allows us to both illuminate these relevant features and illustrate how they interact with each other, such as the originally synchronic real-time nature of the transmission and the sheer volume of such messages both imposing a need for message length to be minimised; and explore how advances in technology may have changed the nature of such messages, such as longer and more grammatical NOTAMs being made possible by it becoming easier to transmit and retrieve them.

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