Date and Time on the Internet

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    A revised version of this draft document will be submitted to the
    IESG as a Proposed Standard for the Internet Community. Discussion
    and suggestions for improvement are requested. This document will
    expire six months after publication. Distribution of this draft is
    unlimited.

1. **Introduction**

    Date and time formats cause a lot of confusion and interoperability
    problems on the Internet. This document will address many of the
    problems encountered and make recommendations to improve
    consistancy and interoperability when representing and using date
    and time in Internet protocols.

    This document includes an Internet profile of the ISO 8601
    [ISO8601] standard for representation of dates and times using the
    Gregorian calendar.

    Changes from draft -00:
      * added some more definitions and references (fixed NTP reference)

      * language clarifications
      * include rules for day of month and leap seconds
      * disallow hour of 24
      * add registry of named timezones and local time format
      * use . instead of , for fractions of second
      * removed references to AM/PM
      * simplified appendix B program
      * added appendix C program to calculate leap year

    Controversial in last draft, but unchanged:
      * use of "T" as date/time separator. Proposal is to use " " instead,
        but my reading of ISO 8601 does not permit that.
      * suggestion to make minutes offset from UTC optional.
      * interpretation of 2 digit years

    Open issues:
      * See controversial issues above. More comment is welcome.
      * Are more definitions needed?
      * A number of the timezones in the initial registry list are
        duplicates for future times. I already removed the Indiana county
        ones since they all duplicate Indianapolis for future times.
      * Need reference to good article demonstrating year 2000 problems.
      * Need commentary on registry and to set up address for registry.
      * Will add appendix D, E with sample POSIX generation/parsing code
        for section 5.6. Markus Kuhn is working on code.

2. Definitions

    UTC   Coordinated Universal Time as maintained by the Bureau
                 Internaational de l'Heure (International Time Bureau).

    second   A basic unit of measurement of time in the
                 International System of Units.

    minute   A period of time of 60 seconds.

    hour   A period of time of 60 minutes.

    day   A period of time of 24 hours.

    leap year   In the Gregorian calendar, a year which has 366 days.
                 A leap year is a year whose number is divisible by four
                 an integral number of times, except that if it is a
                 centennial year it shall be divisible by four hundred
                 an integral number of times.

      ABNF   Augmented Backus-Naur Form, a format used to represent

permissible strings in a protocol or language, as
defined in [IMAIL].

Email Date/Time Format
The date/time format used by Internet Mail as defined
by RFC 822 [IMAIL] and amended by RFC 1123 [HOST-REQ].

Internet Date/Time Format
The date format defined in section 5 of this document.

For more information about time scales, see Appendix E of [NTP],
Section 3 of [ISO8601], and the appropriate ITU documents [ITU-R-
TF].

3. Two Digit Years

Two digit years are expected to cause great expense to many as the
year 2000 approaches. Many existing computer programs simply add
or subtract 1900 from a two digit year. Such programs will clearly
stop functioning on the year 2000 and will have to be upgraded,
possibly at great expense [XXX - ref to article on IRS year 2000
problems would be cool]. The following requirements are made of
Internet protocols to address this problem:

o Internet Protocols MUST generate four digit years in dates.

o If a two digit year is received, the values 00-49 MUST be
   interpreted as referring to the 21st century (add 2000) and the
   values 50-99 MUST be interpreted as referring to the 20th
   century (add 1900). While different interpretations may result
   in a few more years of 2-digit usability for some applications,
   it is believed that a single interpretation for two digit years
   in all Internet protocols will result in better
   interoperability. In addition, it is reasonable to expect all
   Internet Protocols using 2 digit dates to be upgraded by the
   year 2050.

o It is possible that a program using two digit years will
   represent years after 1999 as three digits. This occurs if the
   program simply subtracts 1900 from the year and doesn't check
   the number of digits. Programs wishing to robustly deal with
   dates generated by such broken software may add 1900 to three
   digit years.

o It is possible that a program using two digit years will
   represent years after 1999 as ":0", ":1", ... ":9", ";0", ...
   This occurs if the program simply subtracts 1900 from the year

        and adds the decade to the US-ASCII character zero. Programs
        wishing to robustly deal with dates generated by such broken
        software should detect non-numeric decades and interpret
        appropriately.

    The problems with two digit years amply demonstrate why all dates
    and times used in Internet protocols MUST be fully qualified.

4. Local Time

4.1. Coordinated Universal Time (UTC)

    Because the daylight rules for local timezones are so convoluted
    and can change based on local law at unpredictable times, true
    interoperability is best achieved by using Coordinated Universal
    Time (UTC).

4.2. Local Offsets

    The offset between local time and UTC is often useful information.
    For example, in electronic mail [IMAIL] the local offset provides a
    useful heuristic to determine the probability of a prompt response.
    Attempts to label local offsets with alphabetic strings have
    resulted in poor interoperability in the past [IMAIL], [HOST-REQ].
    Therefore numeric offsets are now REQUIRED in Internet Mail
    Date/Time Format.

    Numeric offsets are calculated as "local time minus UTC". So the
    equivalent time in UTC can be determined by subtracting the offset
    from the local time. For example, 18:50:00-04:00 is the same time
    as 22:58:00Z.

4.3. Unknown Local Offset Convention

    If the time in UTC is known, but the offset to local time is
    unknown, this can be represented with an offset of "-00:00". This
    differs semanticly from an offset of "Z" which implies that UTC is
    the preferred reference point for the specified time. This
    convention MAY also be used in the Email Date/Time Format.

4.4. Unqualified Local Time

    A number of devices currently connected to the Internet run their
    internal clocks in local time and are unaware of UTC. While the

Internet does have a tradition of accepting reality when creating
specifications, this should not be done at the expense of
interoperability. Since interpretation of an unqualified local
timezone will fail in approximately 23/24 of the globe, the
interoperability problems of unqualified local time are deemed
unacceptable for the Internet. Devices which are unaware of the
time in UTC MUST use one of the following techniques when
communicating on the Internet:

o Use Network Time Protocol [NTP] to obtain the time in UTC.

o Use another host in the same local timezone as a gateway to the
   Internet. This host MUST correct unqualified local times before
   they are transmitted to other hosts.

o Prompt the user for the local timezone and daylight savings
   settings.

5. Date and Time formats

This section discusses desirable qualities of date and time formats
and defines a profile of ISO 8601 for use in new Internet
protocols. Email Date/Time Format lacks many of these
characteristics and its use in new protocols is discouraged.

5.1. Ordering

If date and time components are ordered from least precise to most
precise, then a useful property is achieved. Assuming that the
timezones of the dates and times are the same (e.g. all in UTC),
then the date and time strings may be sorted as strings (e.g. using
the strcmp() function in C) and a time-ordered sequence will
result. The presence of optional punctuation would violate this
characteristic.

5.2. Human Readability

Human readability has proved to be a valuable feature of Internet
protocols. Human readable protocols greatly reduce the costs of
debugging since telnet often suffices as a test client and network
analysers need not be modified with knowledge of the protocol. On
the other hand, human readability sometimes results in
interoperability problems. For example, the date format
"10/11/1996" is completely unsuitable for global interchange
because it is interpreted differently in different countries. In
addition, the date format in [IMAIL] has resulted in

interoperability problems when people assumed any text string was
permitted and translated the three letter abbreviations to other
languages or substituted date formats which were easier to generate
(e.g. the format used by the C function ctime). For this reason, a
balance must be struck between human readability and
interoperability.

Because no date and time format is readable according to the
conventions of all countries, Internet clients SHOULD be prepared
to transform dates into a display format suitable for the locality.
This may include translating UTC to local time.

5.3. Rarely Used Options

A format which includes rarely used options is likely to cause
interoperability problems. This is because rarely used options are
less likely to be used in alpha or beta testing, so bugs in parsing
are less likely to be discovered. Rarely used options should be
made mandatory or omitted for the sake of interoperability whenever
possible.

The format defined below includes only one rarely used option:
fractions of a second. It is expected that this will be used only
by applications which require strict ordering of date/time stamps
or which have an unusual precision requirement.

5.4. Redundant Information

If a date/time format includes redundant information, that
introduces the possibility that the redunant information will not
correlate. For example, including the day of the week in a
date/time format introduces the possibility that the day of week is
incorrect but the date is correct, or vice versa. Since it is not
difficult to compute the day of week from a date (see Appendix B),
the day of week should not be included in a date/time format.

5.5. Simplicity

The complete set of date and time formats specified in ISO 8601
[ISO8601] is quite complex in an attempt to provide multiple
representations and partial representations. Appendix A contains
an attempt to translate the complete syntax of ISO 8601 into ABNF
as defined in [IMAIL]. Internet protocols have somewhat different
requirements and simplicity has proved to be an important
characteristic. In addition, Internet protocols usually need

complete specification of data in order to achieve true
interoperability. Therefore, the complete grammar for ISO 8601 is
deemed too complex for most Internet protocols.

The following section defines a profile of ISO 8601 for use on the
Internet. It is a conformant subset of the ISO 8601 extended
format. Simplicity is achieved by making most fields and
punctuation mandatory.

5.6. Internet Date/Time Format

The following profile of ISO 8601 [ISO8601] dates SHOULD be used in
new protocols on the Internet. This is specified using ABNF as
defined in [IMAIL].

```
date-fullyear   = 4DIGIT
date-month      = 2DIGIT  ; 01-12
date-mday       = 2DIGIT  ; 01-28, 01-29, 01-30, 01-31 based on month/year
time-hour       = 2DIGIT  ; 00-23
time-minute     = 2DIGIT  ; 00-59
time-second     = 2DIGIT  ; 00-59, 00-60 based on leap second rules
time-secfrac    = "." 1*DIGIT
time-numoffset  = ("+" / "-") time-hour ":" time-minute
time-offset     = "Z" / time-numoffset

partial-time    = time-hour ":" time-minute ":" time-second
                   [time-secfrac]
full-date       = date-fullyear "-" date-month "-" date-mday
full-time       = partial-time time-offset

date-time       = full-date "T" full-time
```

5.7. Restrictions

The grammar element date-mday represents the day number within the
current month. The maximum value varies based on the month and
year as follows:

```
Month Number   Month/Year            Maximum value of date-mday
------------   ----------            --------------------------
01             January               31
02             February, normal      28
02             February, leap year   29
03             March                 31
04             April                 30
05             May                   31
06             June                  30
07             July                  31
08             August                31
09             September             30
10             October               31
11             November              30
12             December              31
```

Appendix C contains sample C code to determine if a year is a leap
year.

The grammar element time-second may have the value "60" at the end
of June (XXXX-06-30T23:59:60) or December (XXXX-12-31T23:59:60).
At all other times the maximum value of time-second is "59".

Although ISO 8601 permits the hour to be "24", this profile of ISO
8601 only allows values between "00" and "23" for the hour in order
to reduce confusion.

5.8. **Examples**

Here are three examples of Internet date/time format.

1985-04-12T23:20:50.52Z

This represents 20 minutes and 50.52 seconds after the 23rd hour of
April 12th, 1985 in UTC.

1996-12-19T16:39:57-08:00

This represents 39 minutes and 57 seconds after the 16th hour of
December 19th, 1996 with an offset of -08:00 from UTC (Pacific
Standard Time). Note that this is equivalent to 1996-12-
20T00:39:57Z in UTC.

1990-12-31T23:59:60Z

This represents the leap second insertted at the end of 1990.

6. **Future Events in Local Time**

Some applications (e.g. calendaring) require the representation of repeating or future dates in local time. Because the conversion rules between UTC and local time may change by season and political whim, it is necessary to label the local time zone with a standard label so that if new conversion rules are issued the interpretation of the time relative to UTC can be corrected. For this reason, an IANA registry of timezone names which may be used to represent future dates is necessary.

6.1. **Problems Too Hard to Solve**

Since local timezone rules are set by local governments, the only authoratative reference for such rules is those governments, most of which do not currently provide their rules on line in a computer parsible format. In addition, local timezones were historically set by cities and towns, so attempting to exhaustively enumerate all historical timezones for use in representing past dates is not practical. Attempting to predict where new timezones will be created as a subset of the area covered by an old timezone is also a hopeless prospect.

Therefore the only formal part of the registry will be names for a minimal set of modern timezones. As a convenience, the registry will also include the base UTC offset and daylight savings rules (if determinable) at the time of registration. Because the UTC offset and rules may changed by other bodies, they will not be considered an authoratative part of the registry.

6.2. **Prior Art**

An informal collection of timezone information is currently being maintained by volunteer Internet participants. The current location of this information is:

    <ftp://elsie.nci.nih.gov/pub/>

This is valuable work, and is used in some operating systems. The initial set of timezone names for the IANA registry is a subset of the names collected by this effort.

6.3. **Legal Characters in Timezone Names**

Only the US-ASCII characters A-Z, a-z, 0-9, "-", "_" and "/" are

legal in timezone names. The basic format is the name of a
continent or ocean followed by a "/" followed by the name of a city
or political entity. A political entity may be followed by a "/"
and a subentity if necessary. Timezone names SHOULD use the
standard case in the registry, but MUST be interpreted in a case
insensitive manner.   New timezone names SHOULD use "-" rather than
"_", as the latter is difficult to see in some output contexts.

6.4. Template for IANA Registration of Timezone Names

    To: timezone@XXX
    Subject: Timezone Name Registration

    Timezone Name:

    ISO 3166 2-character country code:

    Description:

6.5. Proceedure for IANA Registration of Timezone Names

The IESG is responsible for appointing a reviewer of Timezone
Names. The job of this reviewer is to verify that the new timezone
name has unique UTC rules, is likely to be used, fits the rules in
section 6.3 and does not conflict unnecessarily with prior art
(especially that mentioned in section 6.2). Within two weeks of
posting, the reviewer must take one of the following actions:

(1) Pass the registration proposal to IANA.

(2) Reject the registration proposal.

(3) Recommend alterations to the registration proposal likely to make
    it acceptable.

In order to assist the reviewer, the address timezone@XXX will be a
public mailing list where registration proposals may be discussed.
Subscription and unsubscription requests may be sent to timezone-
request@XXX.

6.6. Initial List of IANA Timezone Names

The following list will serve as the initial list of IANA Timezone
Names. This list was generated from the archive mentioned in
section 6.2. Some of these timezone names (especially within the

same country) are redundant for future dates, but compatibility
with the timezone names in the databases discussed section 6.2. is
useful.

```
Timezone Name                   Country
-------------                   -------
Europe/Andorra                    AD
Asia/Dubai                        AE
Asia/Kabul                        AF
America/Antigua                   AG
America/Anguilla                  AI
Europe/Tirane                     AL
Asia/Yerevan                      AM
America/Curacao                   AN
Africa/Luanda                     AO
Antarctica/Casey                  AQ
Antarctica/DumontDUrville         AQ
Antarctica/Mawson                 AQ
Antarctica/McMurdo                AQ
Antarctica/Palmer                 AQ
Antarctica/South_Pole             AQ
America/Buenos_Aires              AR
America/Catamarca                 AR
America/Cordoba                   AR
America/Jujuy                     AR
America/Mendoza                   AR
America/Rosario                   AR
Pacific/Pago_Pago                 AS
Europe/Vienna                     AT
Australia/Adelaide                AU
Australia/Brisbane                AU
Australia/Broken_Hill             AU
Australia/Darwin                  AU
Australia/Hobart                  AU
Australia/Lindeman                AU
Australia/Lord_Howe               AU
Australia/Melbourne               AU
Australia/Perth                   AU
Australia/Sydney                  AU
America/Aruba                     AW
Asia/Baku                         AZ
Europe/Sarajevo                   BA
America/Barbados                  BB
Asia/Dacca                        BD
Europe/Brussels                   BE
Africa/Ouagadougou                BF
Europe/Sofia                      BG
Asia/Bahrain                      BH
```

```
        Africa/Bujumbura                    BI
        Africa/Porto-Novo                   BJ
        Atlantic/Bermuda                    BM
        Asia/Brunei                         BN
        America/La_Paz                      BO
        America/Cuiaba                      BR
        America/Fortaleza                   BR
        America/Maceio                      BR
        America/Manaus                      BR
        America/Noronha                     BR
        America/Porto_Acre                  BR
        America/Sao_Paulo                   BR
        America/Nassau                      BS
        Asia/Thimbu                         BT
        Africa/Gaborone                     BW
        Europe/Minsk                        BY
        America/Belize                      BZ
        America/Dawson                      CA
        America/Dawson_Creek                CA
        America/Edmonton                    CA
        America/Glace_Bay                   CA
        America/Goose_Bay                   CA
        America/Halifax                     CA
        America/Inuvik                      CA
        America/Iqaluit                     CA
        America/Montreal                    CA
        America/Nipigon                     CA
        America/Pangnirtung                 CA
        America/Rainy_River                 CA
        America/Rankin_Inlet                CA
        America/Regina                      CA
        America/St_Johns                    CA
        America/Swift_Current               CA
        America/Thunder_Bay                 CA
        America/Vancouver                   CA
        America/Whitehorse                  CA
        America/Winnipeg                    CA
        America/Yellowknife                 CA
        Indian/Cocos                        CC
        Africa/Bangui                       CF
        Africa/Brazzaville                  CG
        Europe/Zurich                       CH
        Africa/Abidjan                      CI
        Pacific/Rarotonga                   CK
        America/Santiago                    CL
        Pacific/Easter                      CL
        Africa/Douala                       CM
        Asia/Chungking                      CN
```

```
        Asia/Harbin                        CN
        Asia/Kashgar                       CN
        Asia/Shanghai                      CN
        Asia/Urumqi                        CN
        America/Bogota                     CO
        America/Costa_Rica                 CR
        America/Havana                     CU
        Atlantic/Cape_Verde                CV
        Indian/Christmas                   CX
        Asia/Nicosia                       CY
        Europe/Prague                      CZ
        Europe/Berlin                      DE
        Africa/Djibouti                    DJ
        Europe/Copenhagen                  DK
        America/Dominica                   DM
        America/Santo_Domingo              DO
        Africa/Algiers                     DZ
        America/Guayaquil                  EC
        Pacific/Galapagos                  EC
        Europe/Tallinn                     EE
        Africa/Cairo                       EG
        Africa/El_Aaiun                    EH
        Africa/Asmera                      ER
        Africa/Ceuta                       ES
        Atlantic/Canary                    ES
        Europe/Madrid                      ES
        Africa/Addis_Ababa                 ET
        Europe/Helsinki                    FI
        Pacific/Fiji                       FJ
        Atlantic/Stanley                   FK
        Pacific/Kosrae                     FM
        Pacific/Ponape                     FM
        Pacific/Truk                       FM
        Pacific/Yap                        FM
        Atlantic/Faeroe                    FO
        Europe/Paris                       FR
        Africa/Libreville                  GA
        Europe/Belfast                     GB
        Europe/London                      GB
        America/Grenada                    GD
        Asia/Tbilisi                       GE
        America/Cayenne                    GF
        Africa/Accra                       GH
        Europe/Gibraltar                   GI
        America/Godthab                    GL
        America/Scoresbysund               GL
        America/Thule                      GL
        Africa/Banjul                      GM
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```
         Africa/Conakry                      GN
         America/Guadeloupe                  GP
         Africa/Malabo                       GQ
         Europe/Athens                       GR
         Atlantic/South_Georgia              GS
         America/Guatemala                   GT
         Pacific/Guam                        GU
         Africa/Bissau                       GW
         America/Guyana                      GY
         Asia/Hong_Kong                      HK
         America/Tegucigalpa                 HN
         Europe/Zagreb                       HR
         America/Port-au-Prince              HT
         Europe/Budapest                     HU
         Asia/Jakarta                        ID
         Asia/Jayapura                       ID
         Asia/Ujung_Pandang                  ID
         Europe/Dublin                       IE
         Asia/Gaza                           IL
         Asia/Jerusalem                      IL
         Asia/Calcutta                       IN
         Indian/Chagos                       IO
         Asia/Baghdad                        IQ
         Asia/Tehran                         IR
         Atlantic/Reykjavik                  IS
         Europe/Rome                         IT
         America/Jamaica                     JM
         Asia/Amman                          JO
         Asia/Ishigaki                       JP
         Asia/Tokyo                          JP
         Africa/Nairobi                      KE
         Asia/Bishkek                        KG
         Asia/Phnom_Penh                     KH
         Pacific/Enderbury                   KI
         Pacific/Kiritimati                  KI
         Pacific/Tarawa                      KI
         Indian/Comoro                       KM
         America/St_Kitts                    KN
         Asia/Pyongyang                      KP
         Asia/Seoul                          KR
         Asia/Kuwait                         KW
         America/Cayman                      KY
         Asia/Alma-Ata                       KZ
         Asia/Aqtau                          KZ
         Asia/Aqtobe                         KZ
         Asia/Vientiane                      LA
         Asia/Beirut                         LB
         America/St_Lucia                    LC
```

```
        Europe/Vaduz                    LI
        Asia/Colombo                    LK
        Africa/Monrovia                 LR
        Africa/Maseru                   LS
        Europe/Vilnius                  LT
        Europe/Luxembourg               LU
        Europe/Riga                     LV
        Africa/Tripoli                  LY
        Africa/Casablanca               MA
        Europe/Monaco                   MC
        Europe/Chisinau                 MD
        Indian/Antananarivo             MG
        Pacific/Kwajalein               MH
        Pacific/Majuro                  MH
        Europe/Skopje                   MK
        Africa/Bamako                   ML
        Africa/Timbuktu                 ML
        Asia/Rangoon                    MM
        Asia/Ulan_Bator                 MN
        Asia/Macao                      MO
        Pacific/Saipan                  MP
        America/Martinique              MQ
        Africa/Nouakchott               MR
        America/Montserrat              MS
        Europe/Malta                    MT
        Indian/Mauritius                MU
        Indian/Maldives                 MV
        Africa/Blantyre                 MW
        America/Ensenada                MX
        America/Mazatlan                MX
        America/Mexico_City             MX
        America/Tijuana                 MX
        Asia/Kuala_Lumpur               MY
        Asia/Kuching                    MY
        Africa/Maputo                   MZ
        Africa/Windhoek                 NA
        Pacific/Noumea                  NC
        Africa/Niamey                   NE
        Pacific/Norfolk                 NF
        Africa/Lagos                    NG
        America/Managua                 NI
        Europe/Amsterdam                NL
        Europe/Oslo                     NO
        Asia/Katmandu                   NP
        Pacific/Nauru                   NR
        Pacific/Niue                    NU
        Pacific/Auckland                NZ
        Pacific/Chatham                 NZ
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```
        Asia/Muscat                        OM
        America/Panama                     PA
        America/Lima                       PE
        Pacific/Gambier                    PF
        Pacific/Marquesas                  PF
        Pacific/Tahiti                     PF
        Pacific/Port_Moresby               PG
        Asia/Manila                        PH
        Asia/Karachi                       PK
        Europe/Warsaw                      PL
        America/Miquelon                   PM
        Pacific/Pitcairn                   PN
        America/Puerto_Rico                PR
        Atlantic/Azores                    PT
        Atlantic/Madeira                   PT
        Europe/Lisbon                      PT
        Pacific/Palau                      PW
        America/Asuncion                   PY
        Asia/Qatar                         QA
        Indian/Reunion                     RE
        Europe/Bucharest                   RO
        Asia/Anadyr                        RU
        Asia/Irkutsk                       RU
        Asia/Kamchatka                     RU
        Asia/Krasnoyarsk                   RU
        Asia/Magadan                       RU
        Asia/Novosibirsk                   RU
        Asia/Omsk                          RU
        Asia/Vladivostok                   RU
        Asia/Yakutsk                       RU
        Asia/Yekaterinburg                 RU
        Europe/Kaliningrad                 RU
        Europe/Moscow                      RU
        Europe/Samara                      RU
        Africa/Kigali                      RW
        Asia/Riyadh                        SA
        Pacific/Guadalcanal                SB
        Indian/Mahe                        SC
        Africa/Khartoum                    SD
        Europe/Stockholm                   SE
        Asia/Singapore                     SG
        Atlantic/St_Helena                 SH
        Europe/Ljubljana                   SI
        Arctic/Longyearbyen                SJ
        Atlantic/Jan_Mayen                 SJ
        Europe/Bratislava                  SK
        Africa/Freetown                    SL
        Europe/San_Marino                  SM
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Africa/Dakar                    SN
Africa/Mogadishu                SO
America/Paramaribo              SR
Africa/Sao_Tome                 ST
America/El_Salvador             SV
Asia/Damascus                   SY
Africa/Mbabane                  SZ
America/Grand_Turk              TC
Africa/Ndjamena                 TD
Indian/Kerguelen                TF
Africa/Lome                     TG
Asia/Bangkok                    TH
Asia/Dushanbe                   TJ
Pacific/Fakaofo                 TK
Asia/Ashkhabad                  TM
Africa/Tunis                    TN
Pacific/Tongatapu               TO
Europe/Istanbul                 TR
America/Port_of_Spain           TT
Pacific/Funafuti                TV
Asia/Taipei                     TW
Africa/Dar_es_Salaam            TZ
Europe/Kiev                     UA
Europe/Simferopol               UA
Africa/Kampala                  UG
Pacific/Johnston                UM
Pacific/Midway                  UM
Pacific/Wake                    UM
America/Adak                    US
America/Anchorage               US
America/Boise                   US
America/Chicago                 US
America/Denver                  US
America/Detroit                 US
America/Indianapolis            US
America/Juneau                  US
America/Los_Angeles             US
America/Louisville              US
America/Menominee               US
America/New_York                US
America/Nome                    US
America/Phoenix                 US
America/Shiprock                US
America/Yakutat                 US
Pacific/Honolulu                US
America/Montevideo              UY
Asia/Tashkent                   UZ
Europe/Vatican                  VA
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     America/St_Vincent                VC
     America/Caracas                   VE
     America/Tortola                   VG
     America/St_Thomas                 VI
     Asia/Saigon                       VN
     Pacific/Efate                     VU
     Pacific/Wallis                    WF
     Pacific/Apia                      WS
     Asia/Aden                         YE
     Indian/Mayotte                    YT
     Europe/Belgrade                   YU
     Africa/Johannesburg               ZA
     Africa/Lusaka                     ZM
     Africa/Kinshasa                   ZR
     Africa/Lubumbashi                 ZR
     Africa/Harare                     ZW
```

6.7. **Local Date/Time Format**

The following format MAY be used to refer to future dates in a
local timezone. This is defined based on the format in section
5.6.

```
zone-char = ALPHA / DIGIT / "-" / "_" / "/"
zone-name = 1*zone_char
               ; case insensitive interpretation
offset-hint = time-numoffset

local-datetime = full-date "T" partial-time " " zone-name
                 [" " offset-hint]
```

A local-datetime represents an event relative to a specific local
timezone. The offset-hint represents the generator's prediction of
what the UTC offset will be at that local time, and may become
incorrect if the rules for the specified zone are changed. The
offset-hint MAY be omitted if the generating program only knows
local time, but the zone-name is REQUIRED. This format SHOULD NOT
be used for timestamps or past events.

6.8. **Examples**

Here are some examples of Local Date/Time Format:

1999-12-31T23:59:59 America/New_York -05:00

This represents a time one (or two if there's a leap second) second

before the year 2000 in the timezone used in New York City in North
America (currently U.S. Eastern Time). The offset-hint is the
number to add to the local time to get an estimate UTC for that
date, so this will probably be equivalent to 2000-01-01T04:59:59Z.

2000-12-31T23:59:59 Australia/Adelaide +09:30

This represents a time one (or two if there's a leap second) second
before the 21st century in Adelaide, Australia. The hint suggests
that this will be equivalent to 2000-12-31T14:29:59Z.

2000-03-31T02:00:00 America/Los_Angeles -08:00

The represents a time of the 2nd hour on the 31st of March in Los
Angeles, USA. The hint suggests that would be equivalent to 2000-
03-31T10:00:00Z. However, if the U.S. government were to adopt the
daylight savings rules currently used by the European Union, which
change daylight savings on the last Sunday of March, then the time
would be equivalent to 2000-03-31T09:00:00Z.

7. Acknowledgements

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mailing list, and participants of the timezone mailing list.

8. References

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9. Security Considerations

     Since the local time zone of a site may be useful for determining a
     time when systems are less likely to be monitored and might be more
     susceptible to a security probe, some sites may wish to emit times
     in UTC only. Others might consider this to be loss of useful
     functionality at the hands of paranoia.

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APPENDIX

A. ISO 8601 Collected ABNF

     ISO 8601 does not specify a formal grammar for the date and time
     formats it defines. The following is an attempt to create a formal
     grammar from ISO 8601. This is informational only and may contain
     errors. ISO 8601 remains the authoratative reference.

     Note that due to ambiguities in ISO 8601, some interpretations had
     to be made. First, ISO 8601 is not clear if mixtures of basic and
     extended format are permissible. This grammar permits mixtures.
     ISO 8601 is not clear on whether an hour of 24 is permissible only
     if minutes and seconds are 0. This assumes that an hour of 24 is
     permissible in any context. Restrictions on date-mday in section
     5.7 apply. ISO 8601 states that the "T" may be omitted under some
     circumstances. This grammar requires the "T" to avoid ambiguity.

ISO 8601 also requires (in section 5.3.1.3) that a decimal fraction
be proceeded by a "0" if less than unity. Annex B.2 of ISO 8601
gives examples where the decimal fractions are not preceeded by a
"0". This grammar assumes section 5.3.1.3 is correct and that
Annex B.2 is in error.

```
date-century    = 2DIGIT  ; 00-99
date-decade     =  DIGIT  ; 0-9
date-subdecade  =  DIGIT  ; 0-9
date-year       = date-decade date-subdecade
date-fullyear   = date-century date-year
date-month      = 2DIGIT  ; 01-12
date-wday       =  DIGIT  ; 1-7  ; 1 is Monday, 7 is Sunday
date-mday       = 2DIGIT  ; 01-28, 01-29, 01-30, 01-31 based on month/year
date-yday       = 3DIGIT  ; 001-365, 001-366 based on year
date-week       = 2DIGIT  ; 01-52, 01-53 based on year

datepart-fullyear = [date-century] date-year ["-"]
datepart-ptyear   = "-" [date-subdecade ["-"]]
datepart-wkyear   = datepart-ptyear / datepart-fullyear

dateopt-century   = "-" / date-century
dateopt-fullyear  = "-" / datepart-fullyear
dateopt-year      = "-" / (date-year ["-"])
dateopt-month     = "-" / (date-month ["-"])
dateopt-week      = "-" / (date-week ["-"])

datespec-full     = datepart-fullyear date-month ["-"] date-mday
datespec-year     = date-century / dateopt-century date-year
datespec-month    = "-" dateopt-year date-month [["-"] date-mday]
datespec-mday     = "--" dateopt-month date-mday
datespec-week     = datepart-wkyear "W"
                    (date-week / dateopt-week date-wday)
datespec-wday     = "---" date-wday
datespec-yday     = dateopt-fullyear date-yday

date              = datespec-full / datespec-year / datespec-month /
    datespec-mday / datespec-week / datespec-wday / datespec-yday

Time:

time-hour       = 2DIGIT ; 00-24
time-minute     = 2DIGIT ; 00-59
time-second     = 2DIGIT ; 00-59, 00-60 based on leap-second rules
time-fraction   = ("," / ".") 1*DIGIT
time-numoffset  = ("+" / "-") time-hour [[":"] time-minute]
time-zone       = "Z" / time-numoffset
```

```
     timeopt-hour       = "-" / (time-hour [":"])
     timeopt-minute     = "-" / (time-minute [":"])

     timespec-hour      = time-hour [[":"] time-minute [[":"] time-second]]
     timespec-minute    = timeopt-hour time-minute [[":"] time-second]
     timespec-second    = "-" timeopt-minute time-second
     timespec-base      = timespec-hour / timespec-minute / timespec-second

     time               = timespec-base [time-fraction] [time-zone]

     iso-date-time      = date "T" time

     Durations (periods):

     dur-second         = 1*DIGIT "S"
     dur-minute         = 1*DIGIT "M" [dur-second]
     dur-hour           = 1*DIGIT "H" [dur-minute]
     dur-time           = "T" (dur-hour / dur-minute / dur-second)
     dur-day            = 1*DIGIT "D"
     dur-week           = 1*DIGIT "W"
     dur-month          = 1*DIGIT "M" [dur-day]
     dur-year           = 1*DIGIT "Y" [dur-month]
     dur-date           = (dur-day / dur-month / dur-year) [dur-time]

     duration           = "P" (dur-date / dur-time / dur-week)

     Periods:

     period-explicit    = date-time "/" date-time
     period-start       = date-time "/" duration
     period-end         = duration "/" date-time

     period             = period-explicit / period-start / period-end
```

B. Day of the Week

   The following is a sample C subroutine loosly based on Zeller's
   Congruence [Zeller] which may be used to obtain the day of the
   week:

```
char *day_of_week(int day, int month, int year)
{
    char *dayofweek[] = {
        "Sunday", "Monday", "Tuesday", "Wednesday",
        "Thursday", "Friday", "Saturday"
    };

    /* adjust months so February is the last one */
    month -= 2;
    if (month < 1) {
        month += 12;
        --year;
    }
    /* split by century */
    cent = year / 100;
    year %= 100;
    return (dayofweek[((26 * month - 2) / 10 + day + year
                      + year / 4 + cent / 4 - 2 * cent) % 7]);
}
```

C. Leap Years

Here's a sample C subroutine to calculate if a year is a leap year:

```
/* This returns non-zero if year is a leap year.  Must use 4 digit year.
 */
int leap_year(int year)
{
    return (year % 4 == 0 && (year % 100 != 0 || year % 400 == 0));
}
```