Time Zone Extension for Fileman Date/Times

respectfully compiled by
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Abstract:

Date and time signatures have been captured in VistA for over 30 years. The date and time has always been in relationship with the site that the reading was taken. This means that the accuracy has been good (to the second), but the time zone has always been in question. This has lead to a number of interesting accommodations, such as, what should happen when there is a time-zone change locally, to daylight savings time or off of daylight savings time. In the VA, this has meant that the system is shut down for an hour in the fall or the time is put forward an hour in the spring. Both of these actions are done to avoid there being duplicate readings that appear to be the same time, but are actually an hour apart. This paper provides a backwards compatible extension to the VistA date/time conventions.

1. The Status Quo

The Current date and time signature is limited in its' representation in that every facility was an island that did not share data directly from facility to facility. The data time formula has been in use within the VA for over thirty years and is still in use today. Any change we propose must take this into account and extend this format to be inclusive of the old format. Assumptions will have to be made when old and new formats are compared or paired for computation. Hopefully the variance of an hour or so over the relative long spans of time involved will be insignificant.

1. VistA Date/Time

VistA Date/Time is represented as a FFFMMDD.hhmmss format which uses the baseline of January, 1700 to mark the time of 0000100.000000. The columns are;

FFF – Years since 1700
MM – Month of the Year
DD – Day of the Month
hh – Hour of the Day
mm – Minute of the Hour
ss – Seconds in the minute

Most of these fields are actually optional but the significant spaces are held as zero if not defined. In the extension we will be suggesting here will include a non-significant implied field, timezone displacement/zone identifier. While it is important to mark time as a standard continuum, there is reason to keep the time in local reference so that it makes sense to the healthcare providers at the time without their needing to do the math in their heads. Whatever the solution that is decided upon, it should not impact the steady flow of information of the healthcare provider and the patient. To this end, the representation of the date/time is nearly always a local event of the observer. Care must be taken by the observer to keep the perspective of the action and the reporting of that action where-ever the observer has requested to see that resultant action.

2. Universal Coordinating Time - Zulu Time

The problem of time zones has been a global issue for a number of centuries. As long as people did not travel great distances, the time adjustment was not recognized as significant until the calculation of the Longitude. With the advent of sea travel and more so with telecommunications, the issue has come to a head. A hospital in one state can have clinics in at least one other time-zone. There may be a situation where two time zones may be involved directly and the whole network impacted globally. The MPI is a case in point. The Master Patient Index services requests from all over the country. Those requests are logged as local events to the MPI in Austin. But in order to provide a base for comparison, the time frame needs to be someplace where there is no Daylight Savings Time correction applied. Each time zone is measured as a plus or minus offset of that one insular longitude, 0 degrees, or Greenwich, England. Why Greenwich? Because the United Kingdom won the toss. Had the French won the calculation of the Longitude before the British, ZULU would have run through Paris. But that is another story. For these purposes here, Universal Co-ordinated Time also known as UCT, ZULU, the primer meridian runs through Greenwich, England and a small town of Lewis to the south of London. There is a bronze stripe that crosses the sidewalk there and one can literally bestride the Easter and Western Hemispheres like a Colossus, one foot to the West of the line, the numbers are minus as you travel toward America, and Positive as one travels East toward the European Mainland. The Universal Coordinated Time (UCT) is the same as Greenwich Mean Time, but more universally accepted due to the use of universal than an actual geographic location.

Now there are more than 24 time zones and a few of them start at some displacement off of the hour. To be a truly international time reference, there needs to be a local reference and a means of identifying the current local offset. This allows the healthcare provider to use their local time reference and leave a mark that can be rectified with Greenwich or any other time zone that this data may be viewed from. This is the key to the success of this approach in that the end user, entering or viewing the data, sees the date and time in the framework that means the most to them, the observers. Frequently the user will enter NOW as the date/time stamp. This should be now as represented by the time observed by person operating from his current location and perception. By the same token, this representation should be resolvable to Universal Coordinated Time (UCT) or ZULU for comparison with events anywhere else on the globe. This helps to map localized events where the event happened and serialize these actions to the relative times that they happen as compared with any other timezone. The person viewing this data/time event from his perspective (and the rest of the world), sees the event happen universally, and comparable to other events anywhere else in the world. But the individual sees the action in terms of his current time frame because that time frame was fixed for him as the offset for his location where he signed in. This is automatic and transparent to the user. The user continues to see all of the time references in his perspective while the time frames are locked to the actual UCT time frames which are carried from every where else.

2. The Enhancement

In examining ISO 8601-:2004(E), we find that date and time representation is described in terms of presentation. As long as the means that we use to store the time signature includes the time zone, any of the representations is possible. We are most interested in the storage of date/time so that any perspective of representation can be accommodated as well as calculating the time differences in events happening in different time zones. The date and time of a traumatic event, an IED (Improvised Explosive Device) or mine incident was the cause of the damage done to the soldier. The efforts of getting the patient stable and able to travel is critical the patient's survival. The recuperative success of the patient will hinge on the ability to get the patient mobilized to a major medical facility by plane for Landstuhl or back to major recuperative care stateside, perhaps at Walter Reed or Eisenhower. The length of time between the incident and the procedures to relieve pressure on the patient's brain can make all the difference. Knowing exactly how many hours elapsed can mean the difference between a vegetative state and a nearly full recovery.

1. Functionalities Required

While VistA date and time handling has a lot of interesting features, there are some interesting new functionalities which will need to be added to the base-line of VistA functionality. These will include the conversion of one timezone to UCT and then the conversion from UCT to local time. Difference calculations will also be available as displacements in decimal days for easier calculations and rapid conversion from one base to another. We are also looking to be producing a Hijri Output Transform, a lunar-based calendar. This will require the time of the last full moon at zenith be logged, but this is a functionality which will be required in Muslim medical facilities.

1. Initialize Location Information from the USER and the LOCATION

When the user logs in, there is a wealth of information which can be gotten from his profile and the location he has logged into. As such, an individual may be active at any number of locations which are reflected in the LOCATION file. At any given time, a location has correspondence with only one time zone. It may change time zones as the user interfaces, but that doesn't matter. The actions performed by this USER are recorded in terms of the time zone he logged in with and any stored times include that time zone signature

2. Accept User Input

At present there are numerous shortcuts that the users are familiar with and have come to expect. All of these will be preserved with the addition of some others.

3. Comparisons

One of the things that is done frequently is to find the differences between two time signatures. In this case, each time signature may be in a different time zone. As such, the two time signatures need to be converted to the same time signature and then calculated with. As such, DECIMAL DAYS is offered as a means of standardizing the inputs so that they can be compared. This will mean the mutual conversion from each of their time zones to UCT and conversion to Decimal Days. The result is a difference, a delta-time which can be represented as years, days, hours, minutes, and seconds, or as a decimal result.

4. Elapsed Times

While this is a difference, it is a value which is needed for the care provider to determine if the additional narcotics or antibiotics are required. Elapsed time may be part of the transported patient history which helps to identify the effectiveness of the administered drugs and help to evaluate if additional or different medications are required.

5. Time Frames

There are numerous times when there needs to be a means of putting events into a consistent time frame. The treatment regime needs to be able to be displayed in an easily digested fashion.

6. Adapt to Other Calendars

We are also looking to be producing a Hijri Output Transform, a lunar-based calendar. This will require the time of the last full moon at zenith be logged, but this is a functionality which will be required in Muslim medical facilities.

2. Utilities Impacted

As this set of new date/time formats and storage are added, there will need to be additional utilities needed to do the more exotic data transforms. We must keep in mind that there will be many variants of time representation which will need to be made equivalent to their corresponding Zulu representation. Keeping the date/time in a format which is locally recognized maintains a partial signature of where an event occurred. Output transforms can adapt the data representation to the needs of the viewer. New utilities will need to be able to take any representation and reduce it to Zulu. Conversely, any Zulu time must be able to be converted to relatively local time. We may also find that being able to convert to decimal date/time will be very valuable to making the date/time calculations easier to do and being able to take the difference and represent the difference of two date/time signatures into a representation of n Days, h hours, m minutes, and s seconds.

1. %DT

%DT is used to accept date and time from the user. An event can also be marked as NOW (today and time) or T (just today), or as a future time, T+4@1145 relative to the person's location who is keying in the values. The person doing the keying has accessed the machine from a specific location and a specific individual with specific duties. A current time zone is associated with this person at this location. These user characteristics can be used in any date/time calculation he might encounter. A system which spans multiple time zones can be used by multiple people without ambiguity.

As some additional twists, to specify relative to Zulu, the user need only key in T+2W@1100Z (2 weeks from today at 11AM Zulu, or 0300 PST). For setting relative to another time zone, the reference might look like T@900L+3 (setting East Coast Time from the West Coast (L is optional and specifies that the local time frame for the person entering the date will be originating zone). T@900Z+3 would be Central Eurasian Time (relative to Zulu). Most input values will be from the view-point of the individual entering the data. Some indication of the unambiguous date/time stamp from the reporter's view will be preserved. Conversion tools which are fast and easy to use will be critical to the proper operation of the date/time utilities.

1. Care Will Be Taken to Not Change The Symbol Table

As the calculations are performed to convert, standardize, present, or store a date, effort is made to keep the impact on the individual's symbol table are small as possible. There is no effort to keep the intermediate values. Effort has been made to make the inputs as arguments into function calls with the results returned to the application. Efforts are made to NEW symbols used to minimize the impact of the calls and reduce synergies.

2. New DUZ Symbols

DUZ is loaded when the User Logs in. It contains the details of the location that the user has logged into. These new symbols are part of the General Interface agreement to make the use of the Time Zone information that much easier and faster to access.

1. DUZ("LD") Local (LOCATION) Displacement

This will make calculating the offset from UCT that much easier as they pertain to actions done at this location and at this specific time. This symbol may be easy enough to get this information from the DUZ("T0") node so that this symbol is redundant from $PIECE(DUZ("T0"),U,3).

2. DUZ("TZ") Local (LOCATION) Time Zone – Unique Abbreviation

This makes the use of the Local Abbreviation for the location this much easier to get to. Again, this may be redundant with $PIECE(DUZ("T0"),U).

3. DUZ("T0") The 0 Node from the XMB Time Zone File

This will make looking up this time zone for other specifics much easier. This can keep the number of references to the Time Zone Global down to nearly once per user/login.

3. The %DT Counterpart is %DTZ

The %DTZ routine will contain many of the original entry points that are identified by the %DT routine, but most of the inputs will be provided by arguments on the calls rather than setting X and looking in Y.

2. %DTC

The Date/time conversion and comparison utilities will be critical. These allow for two different date/time signatures to generate a valid, reasonable, and rational result. By using ZULU time internally, it becomes a convenient base to do comparisons and elapsed times between events.

1. Compare Two Date/time Stamps

This utility will take two date/time stamps, convert them to decimal time, compare them and then return the difference in decimal days. This value can then be used in further calculations or in conversion for display.

2. Convert from Offset Time to Zulu

The conversion from any offset time and Zulu time provides a common base by which the offset time can be compared with another time signature. The process involves the acceptance of the date and the offset from Greenwich. The date/time is converted into decimal time and the offset is converted to decimal offset and added or subtracted from the date/time stamp to generate a decimal Zulu time stamp. This can then be converted into the standard Zulu time/stamp which can be stored or used with another time utility.

3. Convert from Zulu Time to Offset

Once the date/time stamp has been converted to Zulu time, it can then be re-formulated into a different time zone, one that this signature may have never been expressed before. This is important when the person calling for the data needs to see the time in his (or her) own time zone. Obviously, the offset to set the date/time must be provided, A selection of preferred abbreviation codes can be specified to aid in getting the date/time into the appropriate display format.

4. Convert from Zulu Time to Decimal Time

The conversion of Zulu Time to Decimal time is central to the comparison and conversion. Once the differences are calculated, some aspect of display or incorporation may be required to use the calculated difference.

```
GTM>w $$DLDD^RRCDTST($$H2DT^RRCDTST($H)-$H)
4 Hours 23 Minutes 30 Seconds
GTM>w $$DLDD^RRCDTST($$H2DT^RRCDTST($H)-$H)
4 Hours 23 Minutes 34 Seconds
  . . .
4 Hours 23 Minutes 59 Seconds
GTM>w $$DLDD^RRCDTST($$H2DT^RRCDTST($H)-$H)
4 Hours 24 Minutes
GTM>w $$DLDD^RRCDTST($$H2DT^RRCDTST($H)-$H)
4 Hours 24 Minutes 1 Second
GTM>w $$DLDD^RRCDTST($$H2DT^RRCDTST($H)-$H)
4 Hours 24 Minutes 2 Seconds
GTM>w $$DLDD^RRCDTST($$H2DT^RRCDTST($H)-$H+(7/24))
11 Hours 25 Minutes 36 Seconds
GTM>w $$DLDD^RRCDTST($$H2DT^RRCDTST($H)-$H+(7.5/24))
11 Hours 56 Minutes 1 Second
GTM>
```

5. Convert from Decimal Time to Zulu

After all of the conversions are done, the decimal time needs to be converted to another projection of time as needed by the application. Zulu Time is the default. The actual returned representation may be any offset as specified in the call, but Zulu is the default.

```
GTM>W 60*60*24  ;  Seconds in a day = minutes*seconds*hours
86400
GTM>w 86400/24    ;  Seconds between Time Zones
3600
```

```
GTM>w 1/24          ;  3600/86400
.041666666666666666
GTM>
```

6. Display the Remainder of the Difference

Often the results of an operation between two date/time signatures is a signed number. This signed number may represent the difference in time between the two signatures, years, months, weeks, days, hours, minutes, seconds, and fractions of a second. The application needs to provide the precision and the units which will be meaningful to the end user.

7. Storing Date/Time Signatures

The observer's perspective is very valuable to maintain. The timezone is tied to the location that the user is currently associated. The observer may choose to maintain the date/time stamp of the patient and when the reading was take for the patient. This points out the importance of maintaining the patient's perspective of when the reading was taken. One such aspect may be the time of morning that a blood draw event happened. It makes a significant difference that the time reflects the patient's time frame and not the observer. Blood chemistry changes over the day. The readings for an afternoon draw may be significantly different by just a few hours.

8. The %DTC Counterpart is %DTZC

The %DTZC routine will contain many of the original entry points that are identified by the %DTC routine, but most of the inputs will be provided by arguments on the calls rather than setting X and looking in Y.

3. Systemic File Modifications

The current location's displacement from ZULU needs to be supplied from somewhere. It will be these locations which will determine the offset applied by the observer automatically. The KERNEL SITE PARAMETERS and the LOCATIONS Files are natural candidates for this effort. As such, anyone attempting a clinical procedure will use the offset provided by the location that they signed in at. All locations served by a system will not necessarily be from the same time zone (or match the offset found in the KERNEL SITE PARAMETERS file). With regionalization, there may be 2 or more time zones represented at a single regional site at one time. This offset tells us about the location that the action was to happen. The actual offset is a characteristic which resolves to the same ZULU time as for any other location at that same moment. The offset is gotten preferentially from the LOCATION file. But failing to be defined for this process, the off set for the KERNEL SITE PARAMETERS File will be used. In all other cases, the raw UCT time should be employed. Remember that the offset only tells about the location where the actions happened. UCT refers to the global instant that the action happened in a more global way.

As an example, what time would be assigned to the administration of a medication applied to a patient on a 17 hour flight from Landstuhl to Walter Reed in Washington? On a military flight, everything would be applied to the patient in terms of ZULU (UCT). When the timeline for this patient was being reviewed, the recorded times would all be relative to ZULU. The East and West deflections would still be part of the patient record, but the order that the actual actions would be displayed would be accurate and in order. These offsets could be applied to fit the observers bias. A doctor in Landstuhl would see all actions in terms of Middle Eastern Europe time displacement. A doctor at Walter Reed receiving this patient would see all patient related actions in terms of Walter Reed (EST or EDT). The patient's original doctor in theater of action would see all of the dates and times in his location reference in the theater where the doctor still is operating.

1. KERNEL SITE PARAMETERS File Modifications

A new node should be created in the KERNEL SITE PARAMETERS File to hold the displacement. It may also be accomplished as a pointer into a Universal TIME ZONE File, a table which contains an entry for every timezone configuration which has been identified with the appropriate rules for the proper conversion and the proper abbreviations for the different entries. This would go a long way toward making VistA more culturally aware.

2. LOCATION File Modifications

This is the file that everyone has an entry as a default or is able to select one from a list depending where the user is logging in to. This location is associated with a time zone. The rules of how that time zone will change as they are observed,

3. TIME ZONES – A Mailman File

This is a list of all of the recorded time zones and the rules under which they operate. The File Manager File Number for this file is 4.4. Included in this file are the dates and times and their abbreviations for output. This can provide such variability as the time zone in Bangalore, India where they are 30 minutes out of standard. The dates and times of these changes are such that a reverse $ORDER will provide the proper string within that locality for that year. The pointer in the file can point to this set of data elements which can be selected as a lookup cross reference as to when this array is selected.

CROSS REFERENCED BY: CODE(B), TIME ZONE NAME(C)

```
^XMB(4.4,D0,0)= (#.01) CODE [1F] ^ (#1) TIME ZONE NAME [2F] ^ (#2)
          ==>DIFFERENTIAL [3N] ^(#3)DECIMAL TIME DIFFERENCE[4N]^(#4)ORIGIN[5F]
```

4. Various Package Utilities which Calculate Date/Time

There are many packages in VistA which do date/time calculations and manipulations. Many use the standard utilities and many do not. It is far more powerful to standardize the APIs of the standard utilities and use them than to re-invent the wheel. The standard data/time utilities have been crafted to make the process easy to include into new applications, but these utilities are not always in the developer's head when he is creating the application. Building the code again is more expedient than going and searching for the standard utility to do the job. As such, the date/time conversions used in the various packages need to be better understood. if this can be accomplished, a lot of duplicate code can be removed. The difficult part is that the duplicate code is expected to have a side-effect which another part of the application will rely upon. These side-effects are dangerous and make the applications fragile, an difficult to enhance without unintended synergy, subtly changing the application in ways that were not intended. Using standard utilities, there should be no residue left after the call. Only specific symbols which were passed by name to the utility should survive the call. No other symbols in the application or the environment should need to be cleaned up. Depending upon X and Y for inputs and Y for output should not be the case. All standard utilities should be callable as functions which return the result as the return of the function or as results returned via call by name as prescribed by the calling application. It is the responsibility to deal with the communications symbols being passed to and returned by the utility call.

From a system operating system level, all operating systems would operate from UCT time. The time stamp will always be the local offset as provided by the user's offset or the system default offset. This design decision makes it possible for the medical processes across the whole country to be serialized and any action regardless of where or who, finds its proper location in the time stream of events. This may be the most important statement in this whole paper. It will be restated in the results of this paper.

1. Lab

There are various inverted time indexes that put the most recent items in view first. This and some of the other machinations of time could be converted to UCT and inverted. This could allow the combining of more than a singe lab into a single array.

2. Pharmacy

The scheduling of medications for inpatient administration is very common. If a patient is being transported between healthcare facilities, it is important to continue the time-table of administration of antibiotics. By converting into UCT, regardless of his location the medications are initially administered, that course of administrations can be continued uninterrupted.

3. Dietetics

The area of dietetics is usually a lot more forgiving than medications. But with diabetics, a series of small snacks all day seems to be best to keep the blood sugar from falling or too much food from causing the blood sugar to spike. While at most, the criticality is a few hours, so this may not be much of a problem. Some evaluation needs to be included.

4. Nursing

The NURSING aspects are very important. Procedures and samples need to be done at specific times and done in the right order. The use of localized UCT provides an accurate representation of the order in which things are to happen. It will not be impacted by any time zones or time changes that might happen due to locality.

5. Order Entry

Order Entry is one of those actions taken by the healthcare provider that does need to be serialized and be a chain of evidence for when services or drugs were ordered for a specific patient. The delay between the order and the action is an important feature of the patient care. How long did this patient wait for pain-killers before they were administered? Some strong analysis will need to be applied to keep this service functional. If done correctly, the UCT time scale will remove any of the biases between the time systems employed at other sites.

6. and Many More

There are at least 160 different specialties defined in VistA. There are some that are very sensitive to the actual time that a remarked feature in the care of the patient is recorded. In that the VistA system is a unified system, they should all be falling on the same UCT time line. This nicely clarifies the order in which treatments were given to the patient. Little room is left for ambiguity. Unifying the time frame within the integrated hospital system in such a way that it can be easily meshed with a system at another hospital. Calculating the actual number of hours between two events that happened days apart can easily be accomplished.

5. What New Forms of Date/Time Representation Are Needed?

There are new representations of date/time stamps which will be needed and this paper will hopefully be the seed for the establishment of these new data types and suggest how they might be provided as object methods. Many of these manipulations of time are already instantiated in the VistA model in specific applications. the trick is to find these methods, extract and engineer them to be called as functions which return the required format.

1. Re-occurring Time Signatures – Periodic Date/Time

Periodic time happens frequently. It measures the time it takes until the next event. That may be the taking of medication, or the next time a medical procedure needs to be done, or any other activity which requires a relatively fixed delay. Now there may be rules associated with this delay situation, is the patient actually going to be there right on the dot, or is there a few days between the reminder of the appointment and the patient actually presenting himself.

1. Second to Second Monitoring

The second-to-second monitoring is to watch for classes of events which may happen at any time, but are unpredictable. These may involve bed-side monitoring equipment or narcotic manual demand systems. In this last case, the bed-side equipment provides morphine to a patient as the patient presses a button in response to his experienced threshold of pain. The equipment is designed to ignore requests that come too frequently, but service requests up to but not exceeding the prescribed dosage for the patient's weight and body mass. This system has been seen as very therapeutic in that the patient almost never requests all of the narcotic he might have been otherwise subjected to. Accurate measure of the demand by the patient can indicate the degree of the patient's actual pain and the level of his addiction. Fewer addicts are created from such apparatus.

2. Hourly (Short Term Frequency)

Anything short of an hour is usually handled manually. But items which need to be accomplished every few hours, like taking medications, should be schedulable with an hourly trigger. This data type can be part of the characteristic of a procedure or a medication.

3. Weekly (or Longer Periodic Re-occurrence)

A weekly schedule can be required for monitoring healing or the progression of an infection. There are three aspects which are needed for re-occurrence, start time, frequency, and duration. There is common practice which is used in VistA such as “T”, “NOW” (which includes a time component), or “T+1W” which means today plus a week, but we want to be able to have events which auto project themselves into the same time next week, or month or year, or just about any periodicity without needing to write more than the specification for the repeating iteration. There needs to be a form of the date and time format that allows the periodic extrapolation of time into future or past spanning specification which can be easily easily used as a specification for how some action should be applied, such as; twice daily, once a week, every six hours until used up. Perhaps a new form is needed which incorporates the START:FREQUENCY:DURATION. So something like NOW:5h:T+2W would mean starting now, take this medication every 5 hours for the next 2 weeks.

4. Full Moon

The Hijri calendar marks time by the phase of the moon. Their month changes on the new moon and so there are 12 months of alternating 30 and 31 days each which are liberally sprinkled with leap-days. This may seem a bit arbitrary, but it makes a great deal of sense when you deal in the transport of goods and materials over long trade routes by camel, with very few distinct features. It may take two moons to get from Baghdad to Tehran, 1 month to cover the distance and 1 month to get across the boarder. This is a highly dynamic calendar which is very capable of providing a very regular time indicator (the Moon) which is interpreted as to the beginning or end of the month by clerics. Leap days are added as needed to adjust the affairs of men with the slow pulse of the heavens which are indifferent to the affairs of men. This will be an output transform which will access the mapping of the current local time to the sidereal passage and assigning the current date (different names for their months) and time to the current output. In some respects this is a much more regular calendar than the Gregorian Calendar we are so familiar with. All of their months are very regular. Any two adjacent months are presumptively 61 days in length. Leap days are assigned by the clerics to adjust the months to the New Moon. The actual leap day is determined upon by the location of the observer. The observer is on one side of the zenith of the moon at one location and another location will not have that same leap day. In that there is an exterior component that moves with better than clock-like accuracy, the periodicity of the moon, the beginning of the next month can be declared with some certainty. Eventually everyone gets back onto the proper clock by the beginning of the month. Rules are needed to evaluate the zenith of the moon over any given location and the appropriate leap-days for that location can be assigned, thus yielding an appropriate Hijri Calendar date.

5. Last Thursday of the Month

There are other periods of activity where the event happens more closely aligned to some non-standard aspect of the Calendar. Such events are usually contrived and are set by long tradition, such as Easter and Thanksgiving. The last Thursday of the Month and the fourth Thursday of the month are not necessarily the same day. In 2007, the first of November was on Thursday. The last Thursday of the month was on the 29th. Fourth Thursday was actually on the 22rd of November that year. This year, 2008, there are only 4 Thursdays in

November, the 6th, 13th, 20th, and the 27th. The last Thanksgiving is the 4th Thursday in 2008. So we need tools which will allow the establishment of rules to generate just the right expression to generate the proper selection set.

2. Difference in Time and Location - %DTC

If it is 2PM there, it must be 5PM here. This is a common calculation done many times a day. There is a Kernel utility, %DTC, which does many of these conversions, but not all applications use the tools universally. The calculation of differences of time between two dates that span a month can be a bit of a problem because of the variability of the number of days in each month. Poor February, was there a leap year this year? Was there a special rule for a leap year on the century?

3. Input Transforms

One of the most interesting aspects of VistA has been the breadth of input which is acceptable to the package. There are numerous shortcuts, filters, input and output transforms which work together to make it easy to unify the data as it comes into the system.

Nearly any Date/time input field can be responded to with NOW, or T, or some displacement off of today, T. As one might surmise, these key words in the day-to-day context save a lot of time looking at ones watch and calculating the actual time where they are. NOW is the same time everywhere the word is given, and stored as the current location with the Greenwich offset become a unique and comparable date/time signature which also gives some hint as to the location that the actual event happened. The time aspect of the service can reference any time in the past or the future depending upon the requirement of the field being filled. A future scheduled date/time may be any time from NOW into the future. Any historic reference can be from NOW into the distant past. Additional time and date aspects are also included and may be further enhanced as time goes on.

4. Various Output Functions

As date and time aspects are calculated, there are important situations which should be considered. The reporting of events includes certain aspects which one does not consider when one is adding the data. The aspect of the reviewer is critical to understanding the output transform needed to display the data. Is the time that the event happened critical to be displayed in the context of the patient, or the observer? The time that a blood sample was drawn should be displayed from the patient's point of view, and not the observer. The expected blood values change with regard to the time of day and the proximity to a meal. An observer on the East Coast may forget that the chart he is reviewing is for a patient on the West Coast. The readings being evaluated will be strange for the local time, but normal for the Patient's time. In order to remove such potential ambiguities, the time zone or the offset should be displayed to the observer. This is why it is so important that the time reflect the patient's location and not Zulu. Comparisons are what the computer is good for, and making the healthcare provider do the conversion is not only time consuming, but error prone.

1. Transfer

Patient transfers are notorious for being difficult. A patient being moved from the middle-east may travel to Germany (Landstuhl) and then back state-side. Each step of the way, the patient may require medications and continuity of care. This information is being collected as the transport is crossing various date/time zones. Being able to convert all of these time signatures to GMT, Zulu is a god-sent to building a rational chain of events for this patient. As the MATS (Military Air Transit Service) flight chases the day, it makes sense to be recording the time in transit as UCT. The transfer to the new time zone can be accomplished as an event. Having spoken with a nurse on such flights, it has come to the attention of this investigator that the event times are actually recorded in terms of date and time in relation to ZULU or UCT when in flight regardless of where the plane is going.   This development actually works in favor of the current proposal. When the plane lands, the local correction can be made for the local observers who are reviewing the recent history of the patient. All drug and procedure administrations are converted to the local observer's time perspective.

2. Presentation

The presentation of the date/time stamp provides a queue as to;

1 Where the event happened (where-ever the event happened with displacement),
2 Who is viewing the date/time information (where ever the observer is),
3 How it is collated (converted to GMT and then indexed).

This provides a number of potential means of ordering or viewing this specific event data. This provides flexibility which the end user (observer) may utilize to make the data more meaning full to the observer.

3. File Space Impacted

In the past most file systems suffered when a field was extended. They had problems of recalculating and re-blocking the records in the database. Snug records get down-right cramped extending an individual field by just a few characters. In VistA, the data dictionary may be expanded and no actual records get re-sized.

1. Traditional Date/Time Entry and Storage

The representation of date and time is currently shown internally as two separate forms;

```
FFFMMDD.HHMMSS+hhmm   :  New Fileman Date
 |   |   |   |    |   |  |  |  +----  Time Zone Minutes  (Optional)
 |   |   |   |    |   |  |  +-------  Time Zone Hours
 |   |   |   |    |   |  +----------  Time Zone Direction +East -West of Zulu
 |   |   |   |    |   +-------------  Seconds
 |   |   |   |    +-----------------  Minutes
 |   |   |   +----------------------  Hours
 |   |   +--------------------------  Day of the Month
 |   +------------------------------  Month
 +----------------------------------  Year (Fileman Style, YYYY-1700=FFF)
```

And the more geographically accurate and exact though potentially synonymous literal timezone named form. While this seems a bit more arbitrary, it is actually very exact and each time zone has a distinct relationship with ZULU (Z). Our season change only represents our respect for one of these time zones over another one. As long as the representation remains the same, then the universal time frame is intact.

```
FFFMMDD.HHMMSS:AAA   :  New Fileman Date
 |   |   |   |    |   |  |  |
 |   |   |   |    |   |  |  +-------  Time Zone Name (at least 1 Upper Case Alpha)
 |   |   |   |    |   |  |               or the sign and offset (+10, -8) from UCT
 |   |   |   |    |   |  |               If hours only, 1 or 2 digits, if minutes are involved
 |   |   |   |    |   |  |               then it is the sign and 4 digits, two for hour, two
 |   |   |   |    |   |  |               for minutes, -0230 for New Foundland.
 |   |   |   |    |   |  +----------  Zone Name Separator (optional)
 |   |   |   |    |   +-------------  Seconds (optional)
 |   |   |   |    +-----------------  Minutes (optional)
 |   |   |   +----------------------  Hours (optional)
 |   |   +--------------------------  Day of the Month
 |   +------------------------------  Month
 +----------------------------------  Year (Fileman Style, YYYY-1700=FFFF)
```

The final representation of date and time is that provided by $HOROLOG as described by the ANSI Standard.

JJJJJ,SSSSS

```
 |       +-----  Seconds since Midnight
 +------------  Julian Days since January 1st, 1841
```

As one can readily see, there is no adjustment currently for the $H. It may be appended as;

```
JJJJJ,SSSSS,+ssssss
 |       |     ||    +----   Seconds Displacement From Zulu (3600 X hours displacement)
 |       |     |+---------   Direction of Displacement, + East, - West
 |       |    +-----------   Additional Comma Separator beyond the ANSI Standard
 |      +----------------  Seconds since Midnight
 +----------------------  Julian Days since January 1st, 1841
```

This will require a change to the ANSI standard, but should solve a number of issues currently perceive and yet to be identified. This format should be backwards compatible with previous use of the $HOROLOG.

2. Data At Rest on Backup Media

Data at rest in archives reflect the old date and time signatures. The solution proposed here does not break the old dates, but adds significant data for comparison between facilities. As time goes by, the differences and the assumed locations will help to determine the actual ZULU time. As time goes by, the differences will means less and less. In context, the date and time differences are currently assumed to be consistent with the location where the readings were originally taken. If comparisons are needed, then the locations' offset can be determined and then applied by the contemporary analysis tools.

3. Exported Data via;

Moving data from one repository to another is an important aspect to consider. Is the time that these things are displayed as important to the patient context, the physician's context, or the observer's context. Is it more important that the time that an action happened be more important to the patient (when the pill was given), the physician, (has the patient been on the anti-biotics for at least 24 hours before the fever broke?), or the observer (did the patient expire before or after the will was notarized?).

1. Messaging

While messaging is an important means of process-to-process communications, it is usually the means that is used to communicate between processes on the same machine. This is also the technique that will be used to communicate with non-VistA interfaces.

2. Protocols

There are expected formats for receiving time related data. They will be described in the protocol for the various protocols that might be used for inter-process communications.

3. Backups

The storage of dates on backups is important to understand. More than likely, the format of the date and time may have modified over the years. The effort of presenting the data and time properly is more of an output transform that may need to take place before any date is exported. The questions that will need to be asked are;

What is the location of the facility where the data was recorded and the actions took place?

What time zone(s) were in effect during the period that the readings were taken?

Are there special rules that applied during the time that the readings were being taken (leap year, extended Daylight Savings Time as happened in 2008)?

4. Export Mechanisms

The means of transfer of these dates and times is two fold. One, is this a presentation date/time, if so, then the viewpoint of the reader or the subject will need to be respected. Two, if this date/time to be used in calculation, then the date/time needs to be resolved to ZULU to account for the other date/time potentially coming from a different timezone. Both dates and times will need to be converted to the common ground point, ZULU (or GMT). Differences are easier to deal with both dates justified to a common timezone. The Universal Coordinated Time (UCT) is the same as Greenwich Mean Time, but more universally accepted due to the use of universal than an actual geographic location.

1. Messaging

The messaging between systems means that data at rest in one location is bundled up to be sent to another location to be put back to rest, displayed, or otherwise utilized. This is commonly done with messaging. The message can be compiled with other data elements and pushed to a second machine to be unpacked. The precision used in the message will be reflected in the message. The receiving site should assume no more precision than that which is presented.

2. XML/RPC

XML and RPC are some protocols which carry data and time in a variety of formats.

The programmer needs to understand the precision needed to be preserved in these transport mechanisms.

3. Backups

Backups are the ultimate data at rest. It requires that the data be represented so that it can be picked up and used as losslessly as possible. The way that the data is stored in the database should be the same precision as will be stored one the backup.

4. Packed Backups

These are extensively the same as the regular backup, but the backup process crushes out space in a way that makes it easy to reconstitute back to its original form, but smaller for easier transmission or storage.

3. Conclusion

Most VistA systems were only required to provide a single time zone, so each measured time as though they were the center of the universe. With the internet and remote data views, this is no longer the case. A consult may happen from many time zones away. What time does the consult put on his observations? The observations should be patient centric. When reading the consult notes, what time is reflected to the reader concerning when the consult took place? It can be either, the patient or the consultant depending upon the report and who the observer is. This new extension to the basic VistA model does not need to break anything, but it does provide the opportunity to project the time as needed. If the consult is being accessed to compute the consultant's billable clinical time, then it is relative to the consultant. If the query is to serialize a series of actions done for the student, then the time would be relative to the patient. This technique provides many options which had not been foreseen. Suppose there is a series of actions that happened in other parts of the world, the raw GMT time could be used to keep all of these actions from happening out of sequence.

From a system operating system level, all operating systems would operate on ZULU time. The time stamp will always be the local offset as provided by the user's offset or the system default offset, but the underlying base time will be the same from the Philippines to Puerto Rico. This design decision makes it possible for the medical processes across the whole country to be serialized and any action regardless of where or who, finds its proper location in the time stream of events.

4. Appendix A – Time Zone Comparisons

```
AEST -----------------------------------------E---------------------------
                 10+9+8+7+6+5+4+3+2+1+0-1-2-0-3-4-5-6-7-8
UCT   ----------------------------------------E----------------------------------
          +121110+9+8+7+6+5+4+3+2+1+0-1-2-3-4-5-6-7-8-9101112-
EDT   ----------------------------------------E-----------------------------------
             +8+7+6+5+4+3+2+1+0-1-2-3-4-5-6-7-8-9101112-
EST   ----------------------------------------E-----------------------------------
                     +7+6+5+4+3+2+1+0-1-2-3-4-5-6-7-8-9101112-
NST     --------------------------------------E---------------------------------
                +9+8+7+6+5+4+3+2+1+0-1-2-3-4-5-6-7-8-9101112-
NDT     --------------------------------------E---------------------------------
                10+9+8+7+6+5+4+3+2+1+0-1-2-3-4-5-6-7-8-9101112-
```

Note: The same event happens in all time zones, but from the perspective of the observers in each time zone, at different hours of the day, but actually at the same instant. As long as the time and the time zone is known, then the time can be mapped to UCT and hence to any other time zone.

5. Appendix B – Time Zones Enumerated

GLOBAL TIME ZONES LIST OCT 6,2008 04:14 PAGE 1

ABREVIATION	ORIGIN	OFFSET FROM GMT	ZONE NAME
Y	Military	-12	Yankee Time Zone
X	Military	-11	X-ray Time Zone
HAST	North America	-10	Hawaii-Aleutian Standard Time
W	Military	-10	Whiskey Time Zone
AKST	North America	-9	Alaska Standard Time
HADT	North America	-9	Hawaii-Aleutian Daylight Time
HNY	North America	-9	Heure Normale du Yukon
V	Military	-9	Victor Time Zone
AKDT	North America	-8	Alaska Daylight Time
HAY	North America	-8	Heure Avancée du Yukon
HNP	North America	-8	Heure Normale du Pacifique
PST	North America	-8	Pacific Standard Time
U	Military	-8	Uniform Time Zone
HAP	North America	-7	Heure Avancée du Pacifique
HNR	North America	-7	Heure Normale des Rocheuses
MST	North America	-7	Mountain Standard Time
PDT	North America	-7	Pacific Daylight Time
T	Military	-7	Tango Time Zone
CST	North America	-6	Central Standard Time
HAR	North America	-6	Heure Avancée des Rocheuses
HNC	North America	-6	Heure Normale du Centre
MDT	North America	-6	Mountain Daylight Time
S	Military	-6	Sierra Time Zone
CDT	North America	-5	Central Daylight Time
EST	North America	-5	Eastern Standard Time
HAC	North America	-5	Heure Avancée du Centre
HNE	North America	-5	Heure Normale de l'Est
R	Military	-5	Romeo Time Zone
AST	North America	-4	Atlantic Standard Time
EDT	North America	-4	Eastern Daylight Time
HAE	North America	-4	Heure Avancée de l'Est
HNA	North America	-4	Heure Normale de l'Atlantique
Q	Military	-4	Quebec Time Zone
ADT	North America	-3	Atlantic Daylight Time
HAA	North America	-3	Heure Avancée de l'Atlantique
P	Military	-3	Papa Time Zone
O	Military	-2	Oscar Time Zone
N	Military	-1	November Time Zone
GMT	Europe	+0	Greenwich Mean Time
UTC	Europe	+0	Coordinated Universal Time
WET	Europe	+0	Western European Time
Z	Military	+0	Zulu Time Zone
BST	Europe	+1	British Summer Time
CET	Europe	+1	Central European Time
IST	Europe	+1	Irish Summer Time
MEZ	Europe	+1	Mitteleuropäische Zeit
WEDT	Europe	+1	Western European Daylight Time
WEST	Europe	+1	Western European Summer Time

ABREVIATION	ORIGIN	OFFSET FROM GMT	ZONE NAME
A	Military	+1	Alpha Time Zone
AEST	Australia	+10	Australian Eastern Standard Time
K	Military	+10	Kilo Time Zone
ACDT	Australia	+10:30	Australian Central Daylight Time
AEDT	Australia	+11	Australian Eastern Daylight Time
L	Military	+11	Lima Time Zone
NFT	Australia	+11:30	Norfolk (Island) Time
M	Military	+12	Mike Time Zone
B	Military	+2	Bravo Time Zone
CEDT	Europe	+2	Central European Daylight Time
CEST	Europe	+2	Central European Summer Time
EET	Europe	+2	Eastern European Time
MESZ	Europe	+2	Mitteleuroäische Sommerzeit
C	Military	+3	Charlie Time Zone
EEDT	Europe	+3	Eastern European Daylight Time
EEST	Europe	+3	Eastern European Summer Time
MSK	Europe	+3	Moscow Standard Time
D	Military	+4	Delta Time Zone
MSD	Europe	+4	Moscow Daylight Time
E	Military	+5	Echo Time Zone
F	Military	+6	Foxtrot Time Zone
CXT	Australia	+7	Christmas Island Time
G	Military	+7	Golf Time Zone
AWST	Australia	+8	Australian Western Standard Time
H	Military	+8	Hotel Time Zone
AWDT	Australia	+9	Australian Western Daylight Time
I	Military	+9	India Time Zone
WDT	Australia	+9	Western Daylight Time
WST	Australia	+9	Western Summer Time
ACST	Australia	+9:30	Australian Central Standard Time
HAT	North America	-2:30	Heure Avancée de Terre-Neuve
NDT	North America	-2:30	Newfoundland Daylight Time
HNT	North America	-3:30	Heure Normale de Terre-Neuve
NST	North America	-3:30	Newfoundland Standard Time