# IMPORTING ALMANAC AND TELEMETRY DATA

Whenever a <u>NEW</u> Scenario is created, the ALMANAC, EPHEMERIS, and other TELEMETRY DATA located in <u>c:\Tapestry\Runs\Default</u> is copied into the folder associated with the New SCENARIO and propagated to the time associated with that SCENARIO.

Tapestry will automatically maintain the *synchronization* and *fidelity* of this TELEMETRY when you change the simulation start time, location, or any other global simulation parameters. In a *simulation sense*, you would never have to update the Almanac on your simulator because Tapestry is keeping it <u>current</u>.
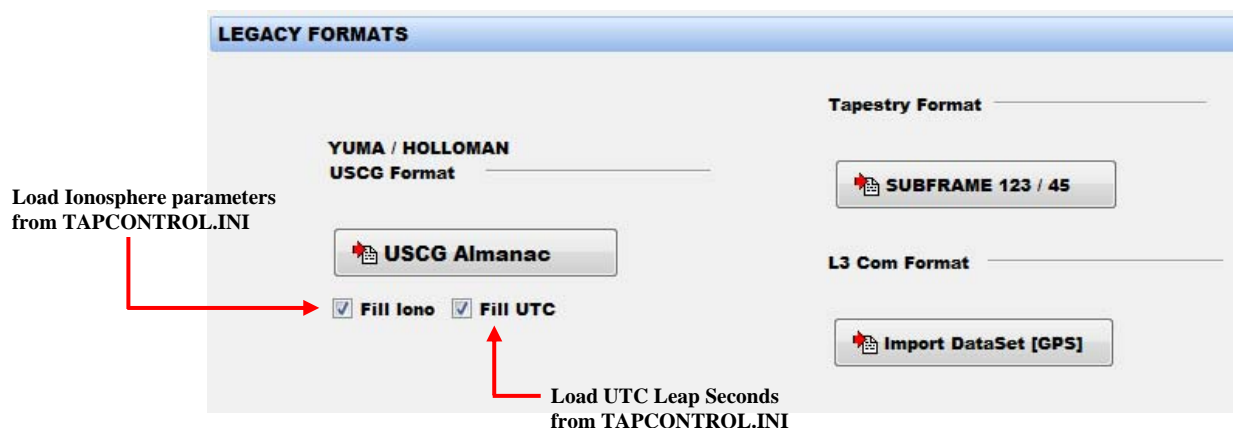
Never the less, should you desire to import a NEW Almanac into your simulator, follow the processes described below.

1. Use the **Edit a Scenario** Group, select the desired Scenario,

2. From **Build Scenario** Main Form, open the import wizard.
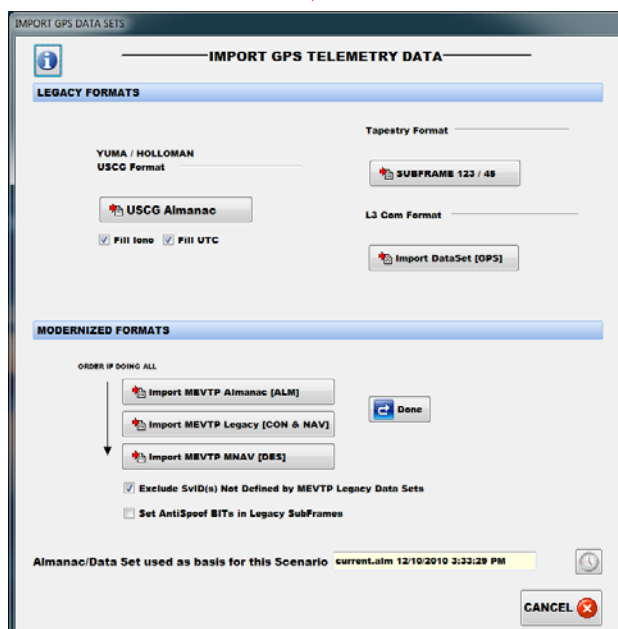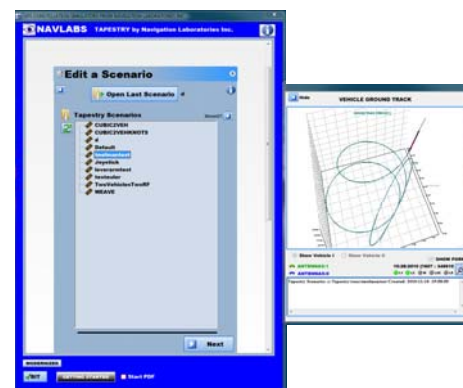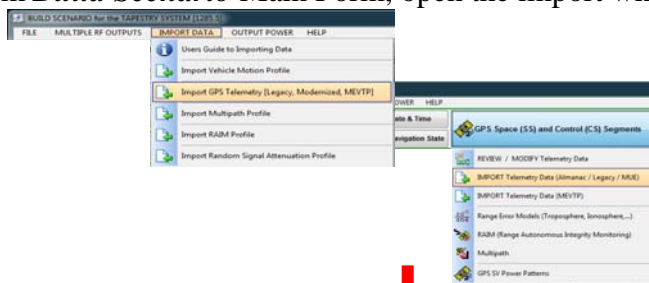
LEGACY FORMATS

Tapestry accepts three methods for importing Legacy Almanac-Data:

LEGACY FORMATS

YUMA / HOLLOMAN
USCG Format _____ Tapestry Format _____

**Load Ionosphere parameters
from TAPCONTROL.INI**

USCG Almanac   SUBFRAME 123 / 45

☑ Fill Iono   ☑ Fill UTC   L3 Com Format _____

Import DataSet [GPS]

**Load UTC Leap Seconds
from TAPCONTROL.INI**

USCG YUMA / HOLLOMAN
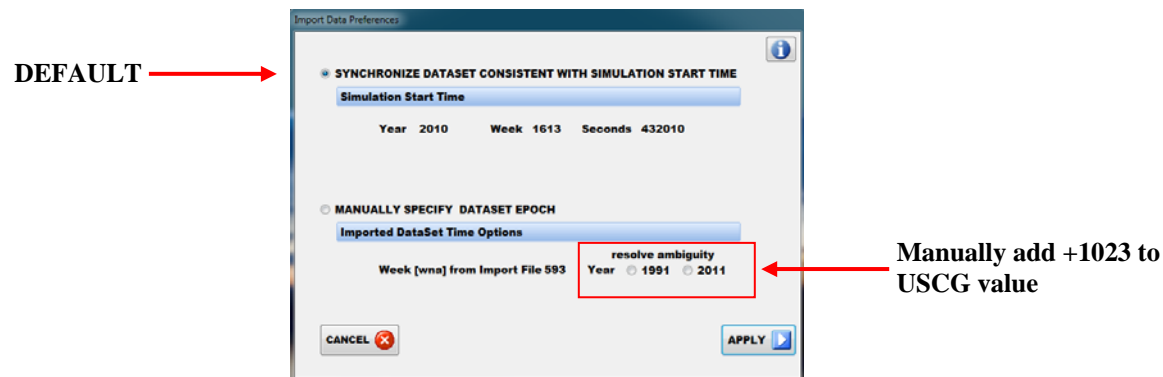
Go to   http://www.navcen.uscg.gov/?pageName=gpsAlmanacs,

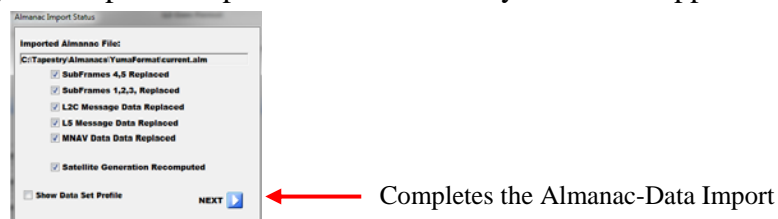Click "Current Almanac - YUMA Format" and download the File,

Transfer the file to **C:\Tapestry\Almanacs**
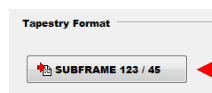
Click - select the file when prompted,

The USCG Format is ambiguous modulo 1023 regarding the Almanac week.
From this form Tapestry either adds 1023 to the Week (to make it current) or
not (usually arises in classified scenarios only).

Import Data Preferences

DEFAULT ———→   ⦿ SYNCHRONIZE DATASET CONSISTENT WITH SIMULATION START TIME

Simulation Start Time

Year   2010   Week   1613   Seconds   432010

○ MANUALLY SPECIFY DATASET EPOCH

Imported DataSet Time Options

Week [wna] from Import File 593   resolve ambiguity
Year ○ 1991 ○ 2011   **Manually add +1023 to
USCG value**

CANCEL ✖   APPLY ▶

Apply to complete the process. The Summary Form will appear.

Almanac Import Status

Imported Almanac File:
C:\Tapestry\Almanacs\YumaFormat\current.alm
☑ SubFrames 4,5 Replaced
☑ SubFrames 1,2,3, Replaced
☑ L2C Message Data Replaced
☑ L5 Message Data Replaced
☑ MNAV Data Data Replaced

☑ Satellite Generation Recomputed

☐ Show Data Set Profile   NEXT ▶   ←——— Completes the Almanac-Data Import

TAPESTRY FORMAT

Select SUB123.DAT and SUB45.DAT from a
Tapestry Scenario. The Data is synchronized to the
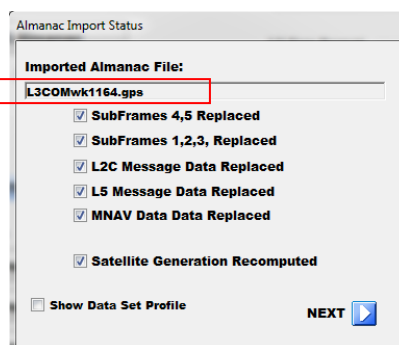(local) Simulation Start Time.

This selection copies Tapestry formatted LEGACY Data files [SUB45.DAT
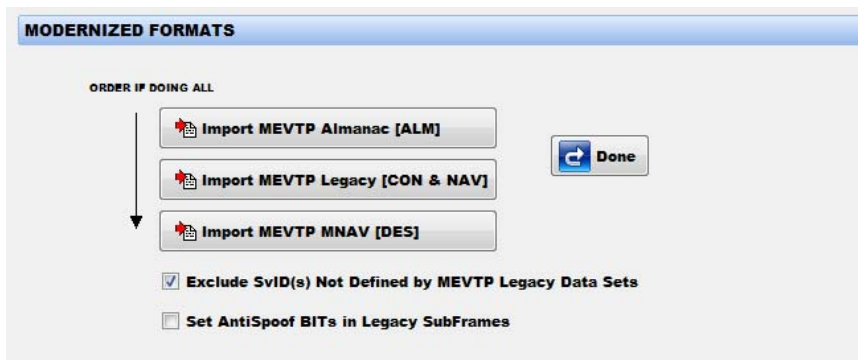SUB123.DAT] to the (local) Scenario.

L³COM FORMAT

This selection prompts for a .GPS File in L3COM SCS2400 Format. This data is
comprised of Almanac-Data, UTC, Ionosphere, and Ephemeris parameters. The Status
Form is presented.

Reflects the .GPS
filename

completes the
process

MODERNIZED FORMATS

In the course of executing the **Modernized Evaluation and Test Procedures (MEVTP)** developed by SPAWAR for the U.S. Government, we provided a gateway to import the various files written by the MEVTP developers. The MEVTP files contain an ALMANAC and multiple EPhemeris and Modernized MCODE Messages and associated telemetry data.

A complete set of MEVTP files includes:

- LEGACY SUBFRAME 4, 5

  This file has the suffix . ALM and differs from the YUMA format in two ways; the week is explicit and only the "test subject" SVID and Data is provided.

MEVTP ALMANAC

```
**** Week 1164 almanac for SV-22 **********
ID:                        22
Health:                    000
Eccentricity:              1.513433456E-002
Time of Applicability(s):  4.055040000E+005
Orbital Inclination(rad):  9.322433472E-001
Rate of Right Ascen(r/s): -8.126052720E-009
SQRT(A) (m^1/2):           5.153658691E+003
Right Ascen at TOA(rad):  -3.011339903E-001
Argument of Perigee(rad):  7.805906534E-001
Mean Anom(rad):           -7.018041015E-001
Af0(s):                    1.878738403E-004
Af1(s/s):                  4.365574569E-011
week:                      1164
```

USCG ALMANAC

```
******** Week 593 almanac for PRN-22 ********
ID:                        22
Health:                    000
Eccentricity:              0.5390644073E-002
Time of Applicability(s):  319488.0000
Orbital Inclination(rad):  0.9324283600
Rate of Right Ascen(r/s): -0.8036295185E-008
SQRT(A)  (m 1/2):          5153.657715
Right Ascen at Week(rad):  0.2709708571E+001
Argument of Perigee(rad): -1.936382651
Mean Anom(rad):           -0.1392269135E-001
Af0(s):                    0.1554489136E-003
Af1(s/s):                  0.0000000000E+000
week:                      593
```

- Week is not Ambiguous
- Limited # SVID Data Provided

- Week is Ambiguous +1023
- All SVID Data Provided

- LEGACY SUBFRAME 1, 2, 3

  These are two file with suffix **.CON** and **.NAV**. The CON file defines the Orbital Parameters and Clock Data for the subject SVID. The NAV file contains SA/AS bit settings, Ionosphere, UTC, and other data items per SVID.

- L$_1$M / L2M Message Schedule and Data specific and unique to each SVID

  This file has suffix **.DES**. The DES file defines the Message Output Profile and the associated Modernized Data Telemetry. Each Message is defined in a tokenized file similar to that shown:
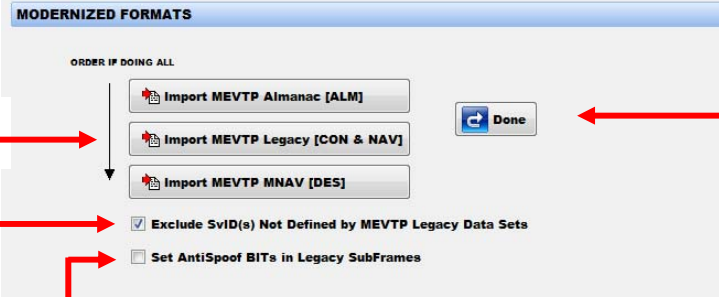
  CAT2 001 L1ME HI AES000 1918 0000

```
*--- Start of Message ---*
GPS Week (week):             1918
GPS Time (sec):              0
*- Footer -*
Message ID:                  6
Alert Flags:                 00010 binary
LM Config Slot 1:            10110 binary
LM Config Slot 2:            00000 binary
LM Config Slot 3:            00000 binary
Spare:                       0x000
TLM:                         0x00000
Reserved (bits 377-381):     0x00
*- Data Block -*
Health:                      001100 binary
AF0 (sec):                   2.18399800360e-005
AF1 (sec/sec):               7.95807864051e-013
AF2 (sec/sec^2):             0.00000000000e+000
TGD (sec):                   4.65661287308e-010
TOC (sec):                   7200
WN_OC (week):                1918
URA_OC:                      7
URA_OC1:                     0
URA_OC2:                     0
URA_DOT_OC:                  0
TOP (sec):                   0
DELTA_A0 (m):                1.36803710938e+003
ECC:                         3.86048352811e-003
I0 (semi-cir):               3.03784927819e-001
OMEGA0 (semi-cir):           -6.00446908269e-001
M0 (semi-cir):               6.25341400271e-001
W (semi-cir):                -1.86071038246e-001
Spare (field 19):            0x00
*--- End of Message ---*
```

Using the files described, the Form details are:

You do not have to complete the sequence. You may exit
   AFTER the ALM import
   AFTER the CON/NAV Import
   AFTER the DES Import.
Press this control to exit out and apply the completed
import data up to that point.

TAPESTRY requires the MEVTP
Import to proceed sequentially

MODERNIZED FORMATS

ORDER IF DOING ALL

Import MEVTP Almanac [ALM]

Import MEVTP Legacy [CON & NAV]   Done

Import MEVTP MNAV [DES]

☑ Exclude SvID(s) Not Defined by MEVTP Legacy Data Sets

☐ Set AntiSpoof BITs in Legacy SubFrames

If no YCODE, you'll have to set the AS Bit in
the HOW to prevent handover. Check this item
to perform this task

Check if SVIDs NOT defined in the ALM/CON/NAV
input file should NOT be generated.

APPENDIX

Overview of the GPS Data Set Propagation

This section presents an overview of the processing involved with maintenance of Legacy Subframe data and L_2C, L_5 and ML_1L_2 message data.

By default the simulator contains a base file set containing Subframes 1-3, Subframes 4-5, and a compatible data set for L_2C, L_5, and ML_1L_2 for both Earth and Spot Links. These files reside in the default folder:

c:\Tapestry\runs\default\sub123.dat	(base Legacy ephemeris)
c:\Tapestry\runs\default\sub45.dat	(base Legacy almanac)
c:\Tapestry\runs\default\SubL2C.dat	(base L_2C dataset)
c:\Tapestry\runs\default\SubL5.dat	(base L_5 dataset)
c:\Tapestry\runs\default\MnMessDataL1Me.dat	(base L_1 MNAV earth)
c:\Tapestry\runs\default\MnMessDataL1Ms.dat	(base L_1 MNAV spot)
c:\Tapestry\runs\default\MnMessDataL2Me.dat	(base L_2 MNAV earth)
c:\Tapestry\runs\default\MnMessDataL2Ms.dat	(base L_2 MNAV spot)

Additionally, default Message Output schedules are provided with the following file names.

> c:\Tapestry\runs\default\MNVMessageProfileSv1.scn
> c:\Tapestry\runs\default\MNVMessageProfileSv2.scn
>   …   ← **One for Each SVID**
> c:\Tapestry\runs\default\MNVMessageProfileSv32.scn
>
> c:\Tapestry\runs\default\L2CMessageProfile.scn
> c:\Tapestry\runs\default\L5MessageProfile.scn

Whenever a NEW scenario is created, these files are copied to the new folder and become the basis for the GPS models.

Changing the initial simulation time - by clicking on the *Clock* icon within *Build Scenario* – to a different start epoch (*relative to the Default folder*) tasks Tapestry to propagate the (time dependant components) of the base subframe data to the new simulation start time. If a new Data Set is imported into the simulation the (time-dependant) contents are propagated to the current simulation start time. In either case, the propagation proceeds as follows:

1. If a Holloman data set is imported, Legacy Almanac & Ephemeris, L_2C, L_5 and MNAV data is constructed based upon the input Almanac data. At this point they all "agree". For all values not contained in the Almanac, eg. the various harmonic corrections, the values are set to zero.

UTC data is set to the current simulation week. Ionosphere parameters are loaded based upon a captured sample set.

2. If a current subframe set is in place, and the simulation start time is changed, the ephemeris data is propagated to the current new simulation epoch such that the Time-of-Ephemeris (TOE) is 1 hour ahead of the current simulation start time rounded to the nearest hour. In no case will the TOE be more than 2 hours ahead of the current simulation time. For example, if the current simulation time is 603000 seconds into the week 1023 (23 hours 30 minutes into August 21 1999), the Ephemeris data will be propagated from the previous simulation (TOE) time to the new TOE computed as:

   New TOW =
   > = 603000 Seconds (week 1023) + 3600 Seconds = 3600 + 800 Seconds into week 1024.
   > = 3600 seconds week 1024 (the 800 sec is rounded down to nearest hour)

   All dynamic parameters, such as the mean anomaly, are propagated to coincide with the TOE computed above. This ephemeris data with the TOE determined as described, is valid for 3 hours past the simulation start time. This is because - according to ICD-GPS-200 - when a four hour ephemeris curve fit is active (the default Tapestry configuration) the TOE shall be in the center of the curve fit interval. The ephemeris is considered valid for four complete hours - 2 hours on each side of the TOE. *To create additional Ephemeris data past the 3 hours of applicability, the "more" function should be used - See the manual for a description of the creation of more ephemeris data.*

3. The Almanac is propagated when the time is changed as follows. The Time-of-Almanac (TOA) is computed to lie as closely as possible to the current simulation time modulo 4096 seconds. That is, for the example time of Week 1023 603000 seconds, the TOA would be given as:

   New TOA =
   > = mod(603000,4096)*4096 = 602112 seconds into Week 1023

   This implies a time of transmission of 3 ½ days <u>previous</u> to this TOA. The time dependent parameters in the Almanac are propagated to be consistent with this TOA.

4. The method of determination of the Almanac TOA described above is in *strict* compliance with ICD-GPS-200 but does not correspond necessarily to the method of determination of the TOA for the current (actual) GPS system. The current GPS system uploads a new Almanac on Thursday of each week (this is not required but corresponds to current standard operating procedure).
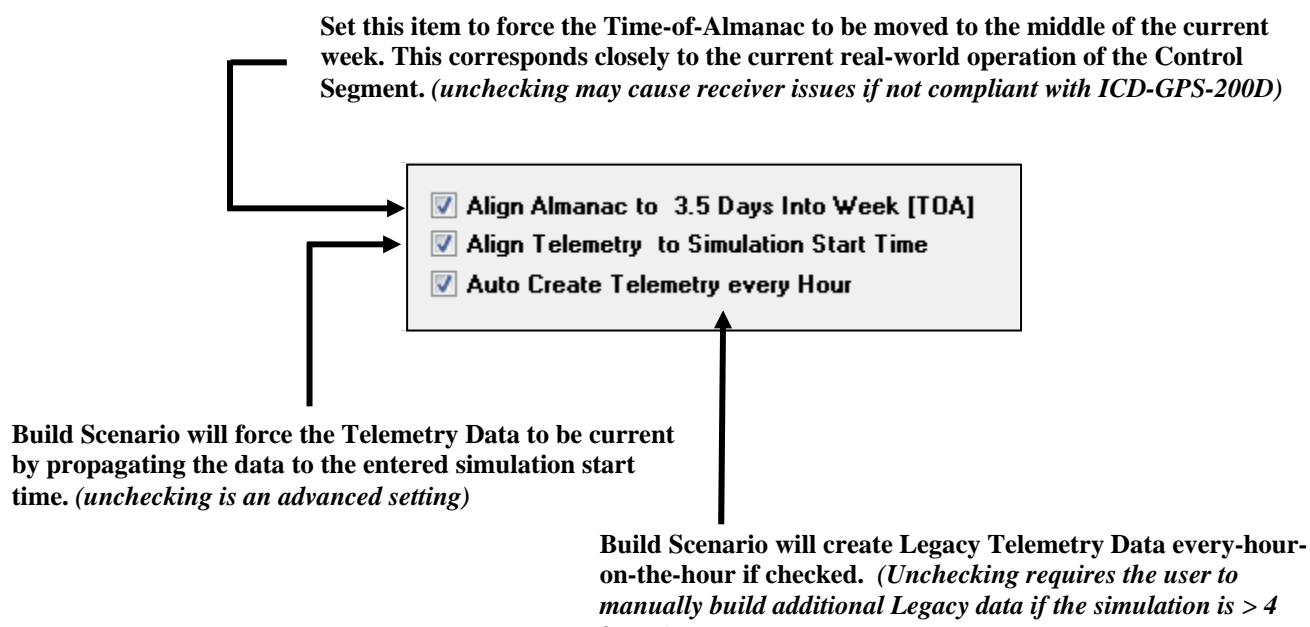
   Based upon this condition, just prior to any week rollover, the Almanac TOA will be in the next week. Thus, in the real world and if the current operational procedures are maintained, on Saturday of week 1023 prior to the week rollover,

the Almanac will already have rolled over to week 1024 (or any other week). This *will not* be the case for Tapestry based upon the current model. The current Tapestry model will have a TOA in week 1023 when the week rolls from week 1023 to 1024. It has been pointed out to NavLabs that certain receivers fail to rollover correctly when this condition occurs. In our opinion this would technically be an incorrect implementation of ICD-GPS-200 for any receiver that depends upon the TOA to be ahead of the current week prior to the rollover.

5. To correspond to the "real world" Tapestry (by default) allows for program settings as follows:

(Access this Form from Build Scenario by clicking on GPS dBase Editor)

Set this item to force the Time-of-Almanac to be moved to the middle of the current week. This corresponds closely to the current real-world operation of the Control Segment. *(unchecking may cause receiver issues if not compliant with ICD-GPS-200D)*

☑ Align Almanac to 3.5 Days Into Week [TOA]
☑ Align Telemetry to Simulation Start Time
☑ Auto Create Telemetry every Hour

Build Scenario will force the Telemetry Data to be current by propagating the data to the entered simulation start time. *(unchecking is an advanced setting)*

Build Scenario will create Legacy Telemetry Data every-hour-on-the-hour if checked. *(Unchecking requires the user to manually build additional Legacy data if the simulation is > 4 hours)*

Unless you do so with a purpose, we strongly recommend you click all 3 check boxes.

When Almanac-Data is imported, the following data is created:

- Legacy data. These are Subframes 1-3 and 4-5 described here:..\..\..\..\Tapestry\Documentation\Addendums\IS-GPS-200D.pdf

- L2C Message Data described here:..\..\..\..\Tapestry\Documentation\Addendums\ICD-GPS-200C-005_L2C.pdf

- L5 Message Data described here: ..\..\..\..\Tapestry\Documentation\Addendums\DO-261_L5.pdf

- MNAV Data described here: ..\..\..\..\Tapestry\Documentation\Addendums\ICD-GPS-700A_IRN-700A-003.pdf