DESCANSO SEMINAR

Mars Exploration Rovers Telecom Launch Preparation and Operation Strategy

April 17, 2003

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Outline

- Mission Timeline
- Launch Operation Timeline
- Telecom Launch/Cruise Preparation
- Telecom Ground Data System Development
  - Telecom Forecaster Predictor and Data Rate Capability File (X-band)
  - Generalized Telecom Predictor and Data Volume Capability File (UHF)
  - Communication Behavior Modeling for Sequence generalization (SATF)
- Detailed Telecom Launch/Cruise Operation Strategy
- Detailed Communication Behavior

Mission Timeline

(taken from J. Ludwinski's ORRR presentation)

~ 1 wk slip

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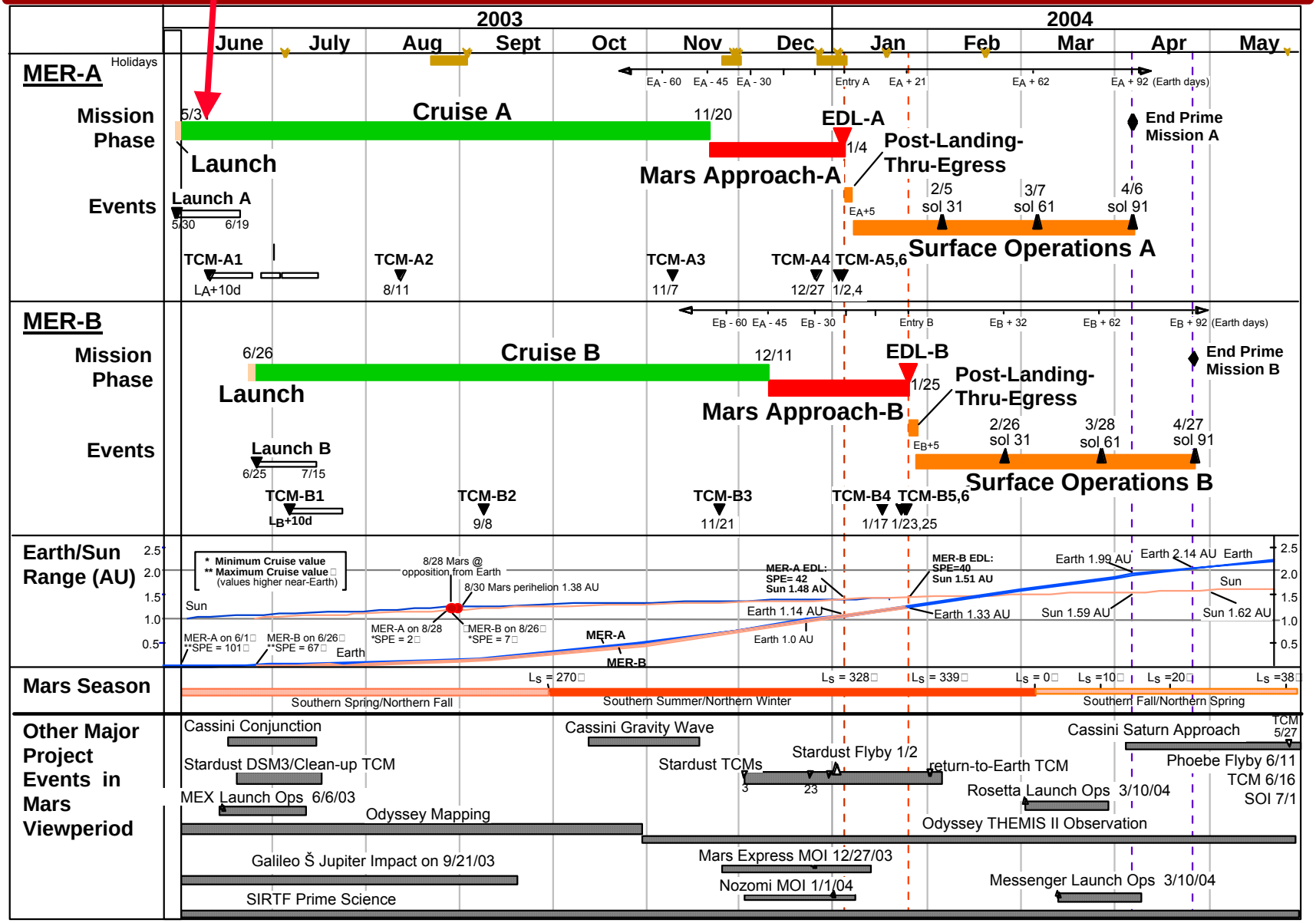
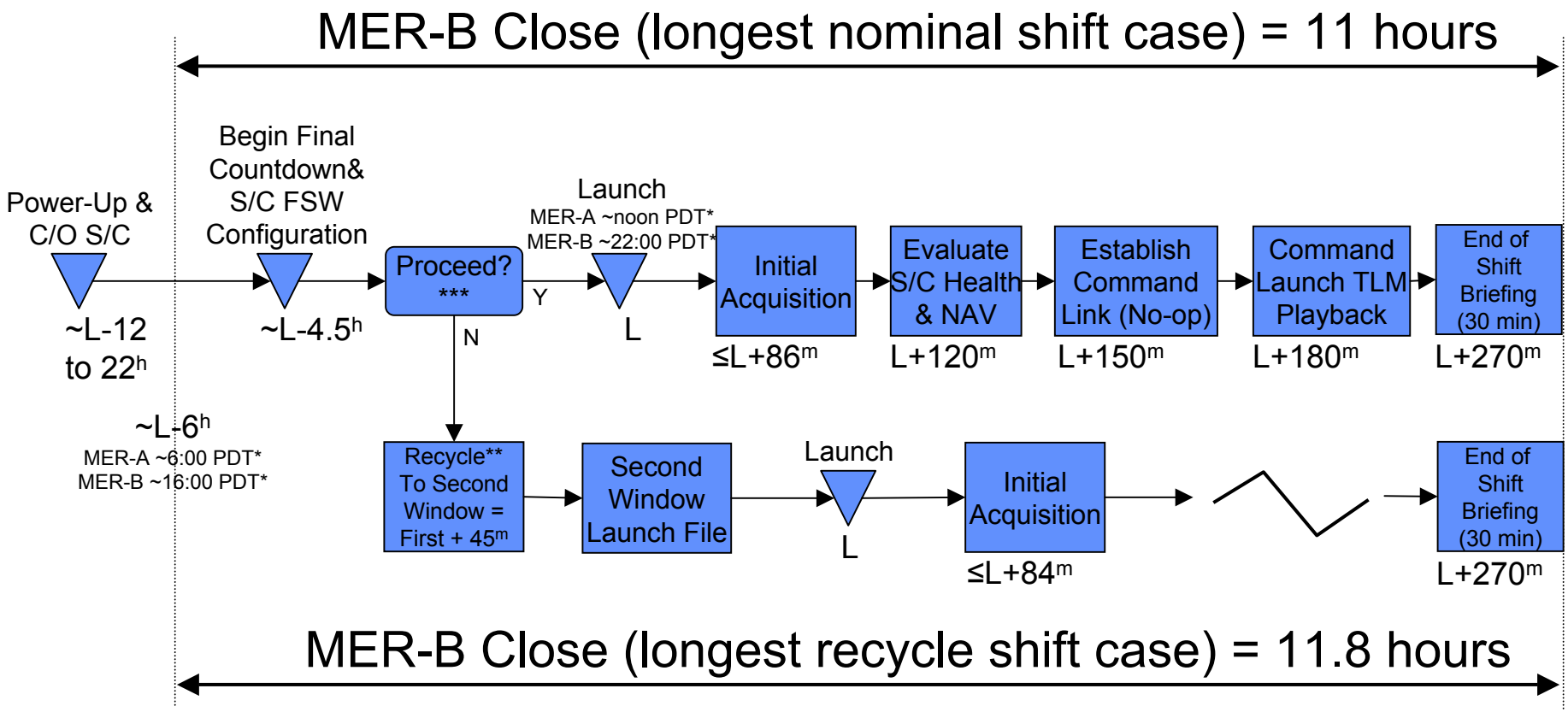


Launch Operations Timeline

(taken from J. Ludwinski's ORRR presentation)



- **Detailed telecom role in MER launch operations to be discussed by Jim Taylor**

Communications Strategy

(taken from J. Ludwinski's ORRR presentation)

- **Normal mode (use default state)**
  - **(7,1/2) code at launch, switch to (15,1/6) code in late November 2003 on <u>both</u> MERs**
  - **Default data rate bases on 10 deg elev, Canberra 34m BWG, 90% weather,**
    - => proposed default rate set: 1185, 504, 300, 120
  - **Two-way, ranging ON (except ΔDOR and EDL M-FSK Dress Rehearsal)**
  - **LGA for ~first 2 months then MGA**
  - **Real-time data only on downlink, recording engineering**

- **Safe Mode**
  - **(7,1/2) code, non-coherent mode, ranging off, 40 bit per second**

- **LGA to MGA switch**
  - **After ACS/NAV characterization but before loss of 1185 b/s in early Sept 03**

Communications Strategy (cont)

(taken from J. Ludwinski's ORRR presentation)

- **Send real-time commands (PACKETIZE_DPS, CHNG_DP_PRI and/or CHNG_DP_GRP_PRI, and ACTIVATE_DPT) at the beginning of every pass that follows a tracking gap to play back the recorded engineering**
- **Send real-time command (ACTIVATE_DPT) near the end-of-track if tracking gap follows to reset to real-time data only**
- **Send real-time command (DELETE_DP_GRP, DELETE_DP) near the end-of-track to delete recorded products which duplicate successfully received real-time data**
- **Send real-time command (SET_EHA_RATE, USE_NONVOL_EHA) to change EHA rates/inclusion criteria as needed**
- **Use communications windows otherwise when temporary change to telecom configuration is desired**
  - **ΔDOR (dozens)**
  - **In association with TCMs (half dozen)**
  - **Selected activities, e.g. instrument and DIMES checkouts (half dozen)**

Launch/Cruise Preparation

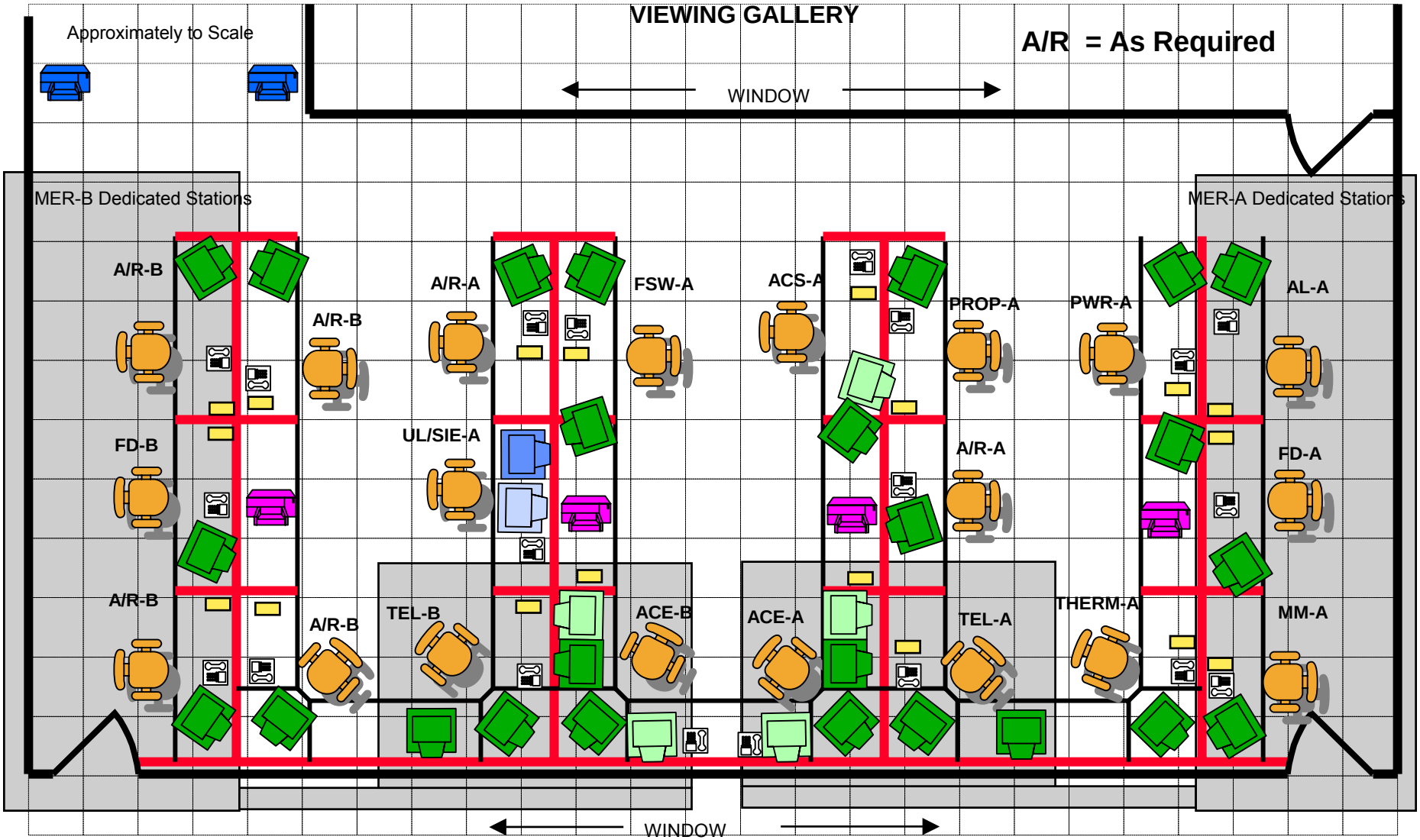
- **Training**
  - **Thread tests and operation readiness tests**
  - **Flight schools**

- **Mission support area (MSA) configurations**
  - **Work with MER GDS SA's and CAT team**
  - **Setup individual and team accounts**
  - **Setup DMD monitor pages including MON-0158 pages**
  - **Setup automated query**

- **Staffing and shifts**
  - **MER-A and MER-B Teams, two members per team**
  - **Round-the-clock launch support planned for 5 days (worst-case)**
  - **Nominal cruise staffing plan ensures individual would participate in both cruise support and surface operation training**
    - Four weeks cruise support (on-station)
    - The fourth week overlaps with the upcoming shift
    - Two weeks surface operation training (off-station)

Cruise MSA (230-109) Station Assignment

(Taken from Henry Stone's MSA_configuration chart on 2/27)



Telecom Team Procedure

- **Telecom uplink product generation and review**
  - **SRET-TP-212**
  - **MER library collection 10405**

- **Telecom downlink analysis and trending procedure**
  - **SRET-TP-213**
  - **MER library collection 10405**

- **Anomalous downlink**
  - **SRET-CP-001**
  - **MER library collection 10327**

- **Anomalous commanding**
  - **SRET-CP-006**
  - **MER library collection 10327**

MER GDS Telecom Tools

MER Telecom Forecaster Predictor (TFP)

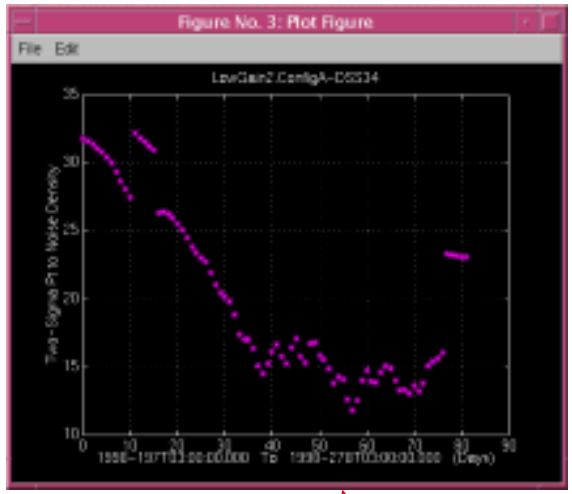
- **Interactive tool that allows telecom analysts of the MER flight operation team to make or verify predictions for the DFE and DTE X-band links between the MER and a DSN station, cruise and surface**
- **Modeling/analysis capabilities**
  - **High-fidelity DSN common models (810-5 compliant, multi-mission)**
  - **High-fidelity mission telecom models (mission-specific)**
  - **Analysis capability to model telecom and attitude interaction**
  - **XML-based interface to model mission parameter dependencies**
- **Time-series prediction**
  - **Receives ephemeris information in the form of SPK file, and attitude information in the form of CK file**
- **Single point prediction**
  - **Receive single value of range, elevation, and antenna pointing angles without the need of predicted SPK and CK files**

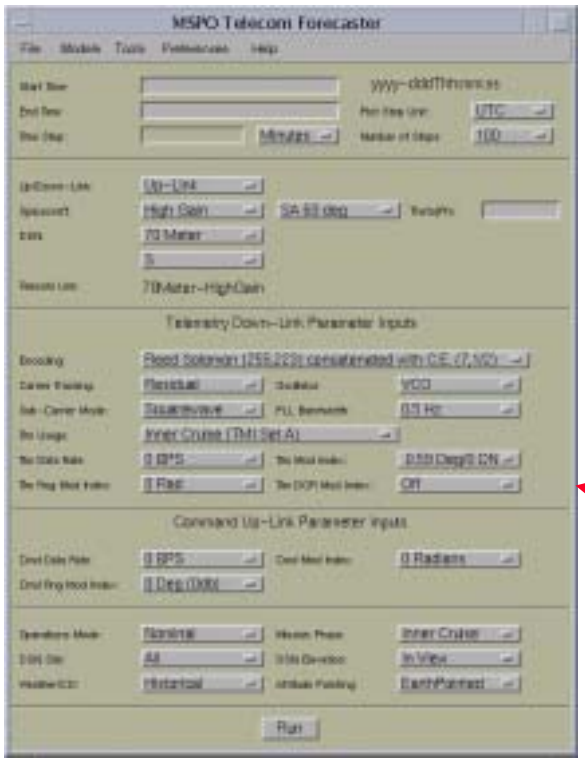
MER GDS Telecom Tools (Cont'd)

MER Generalized Telecom Predictor (GTP)

- **Interactive tool that allows telecom analysts or other members of the MER flight operation team to make or verify predictions for the forward and return UHF links between the MER and an orbiter (Mars Odyssey, MGS)**
- **Modeling/analysis capabilities**
  - **UHF transmitter and receiver models for MER, Mars Odyssey, and MGS**
  - **MER-specific models (e.g. rover orientation model)**
  - **Analysis capability to model telecom and attitude interaction**
  - **XML-based interface to model mission parameter dependencies**
- **Time-series prediction**
  - **Receives ephemeris information in the form of SPK file, and attitude information in the form of CK file, which contains the rover's orientation and tilt information**
- **Single point prediction**
  - **Receive single value of range, elevation, and antenna pointing angles**

TFP and GTP Interactive Mode





DVCF Generation Process Overview

- **Two passes approach**
  - **First pass generates UHF viewperiods (sparse)**
  - **Second pass generates link predicts**

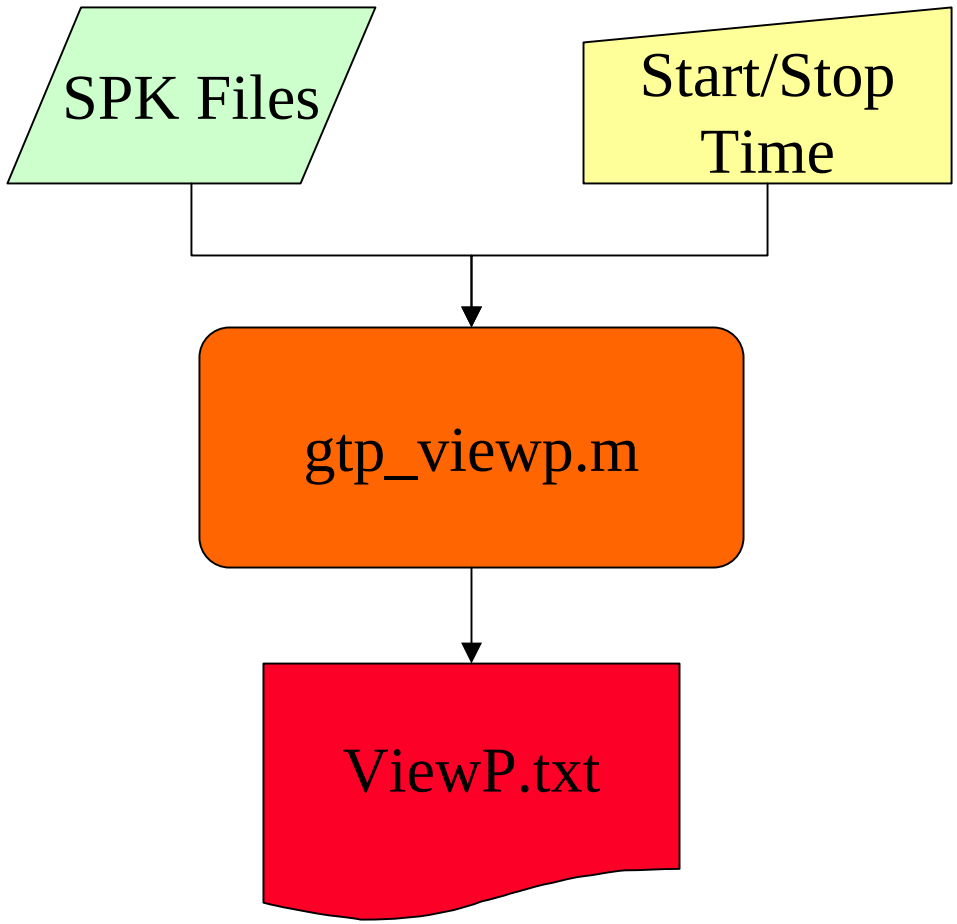
- **Generated files per view period**
  - **72 Pt2No time profiles**
  - **36 data volume summary files**
  - **36 antenna pattern files**
  - **1 UTC time stamp file**
  - **1 data volume summary file**
    - Option is available to keep all files for archiving
    - Currently all but the final DVCF file are deleted

- **Generated 1 super-summary per planning period**

- **Time Requirements**
  - **2 minutes per view period**

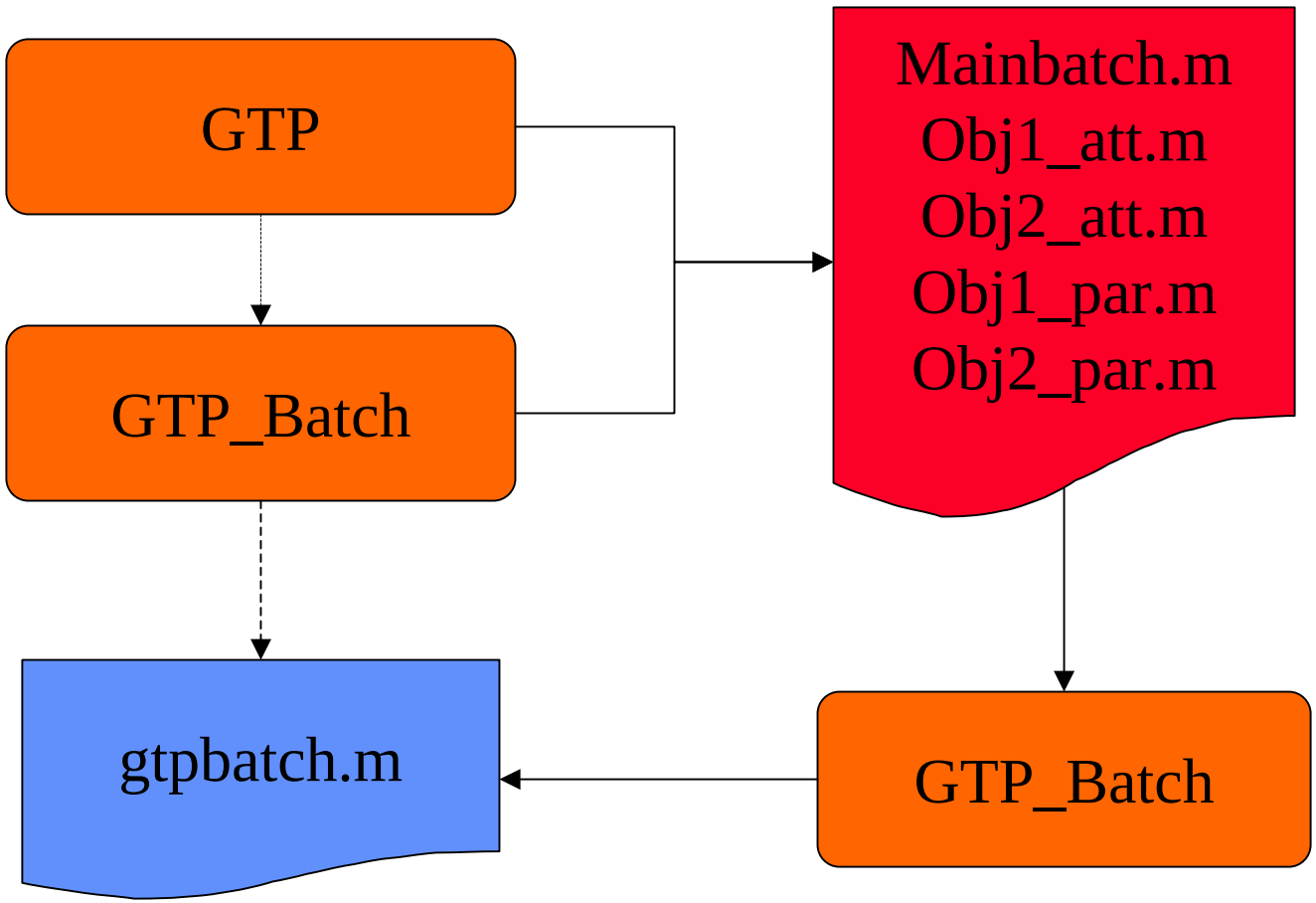
DVCF Generation Process Overview (Cont'd)

- **First Pass**



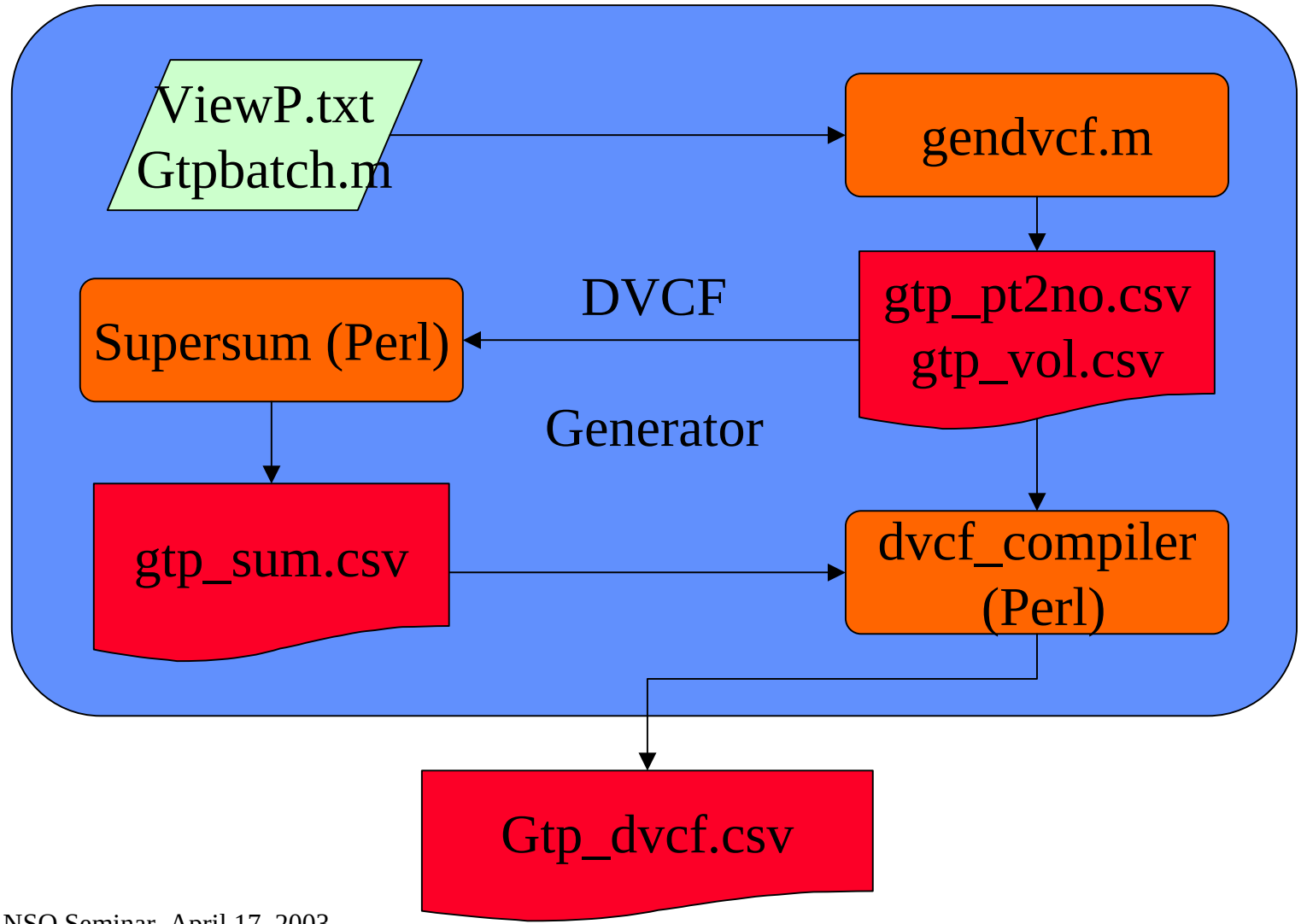
DVCF Generation Process Overview (Cont'd)

- **Second Pass – setup link and attitude configurations**



DVCF Generation Process Overview (Cont'd)

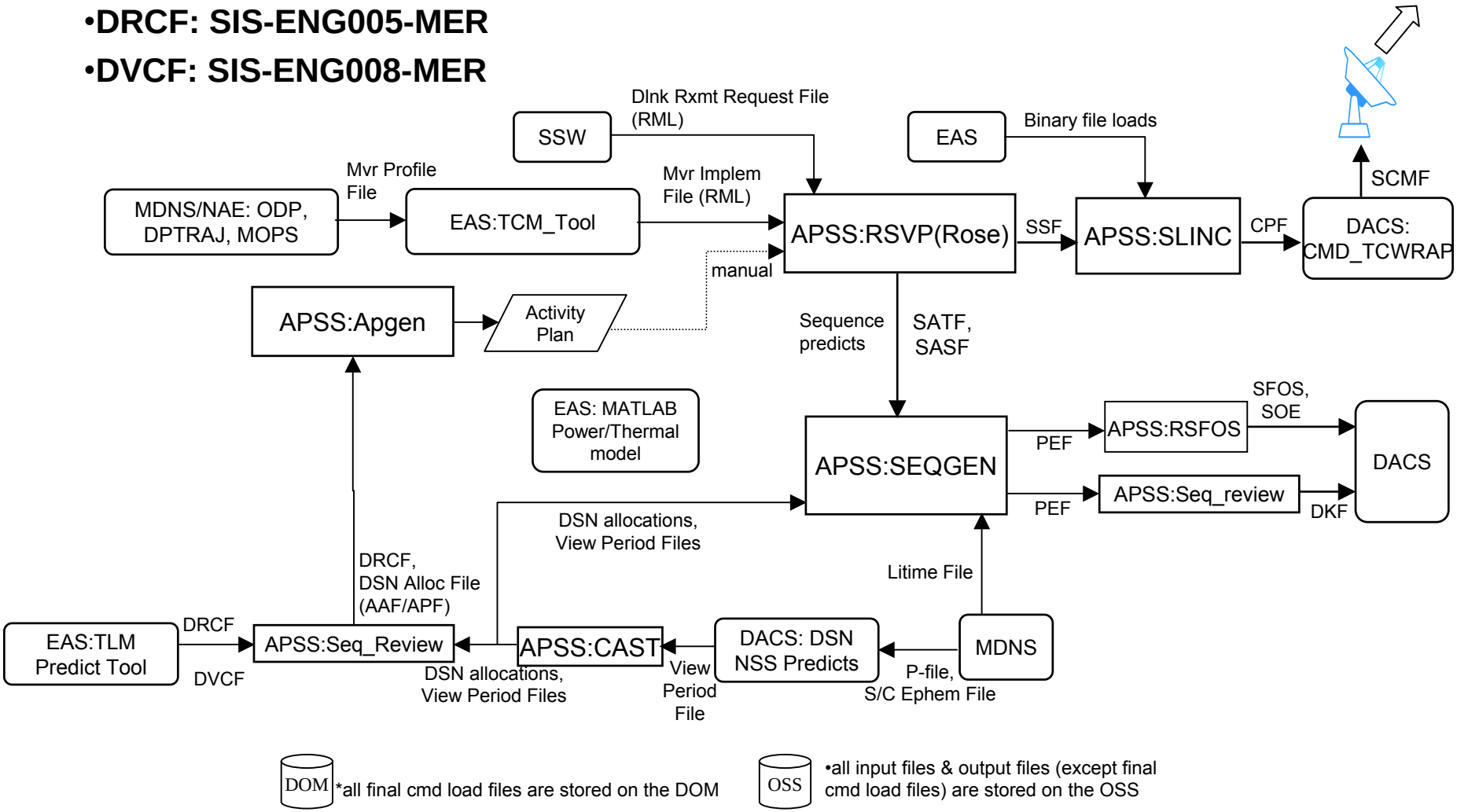
- **Second pass – generate link products**



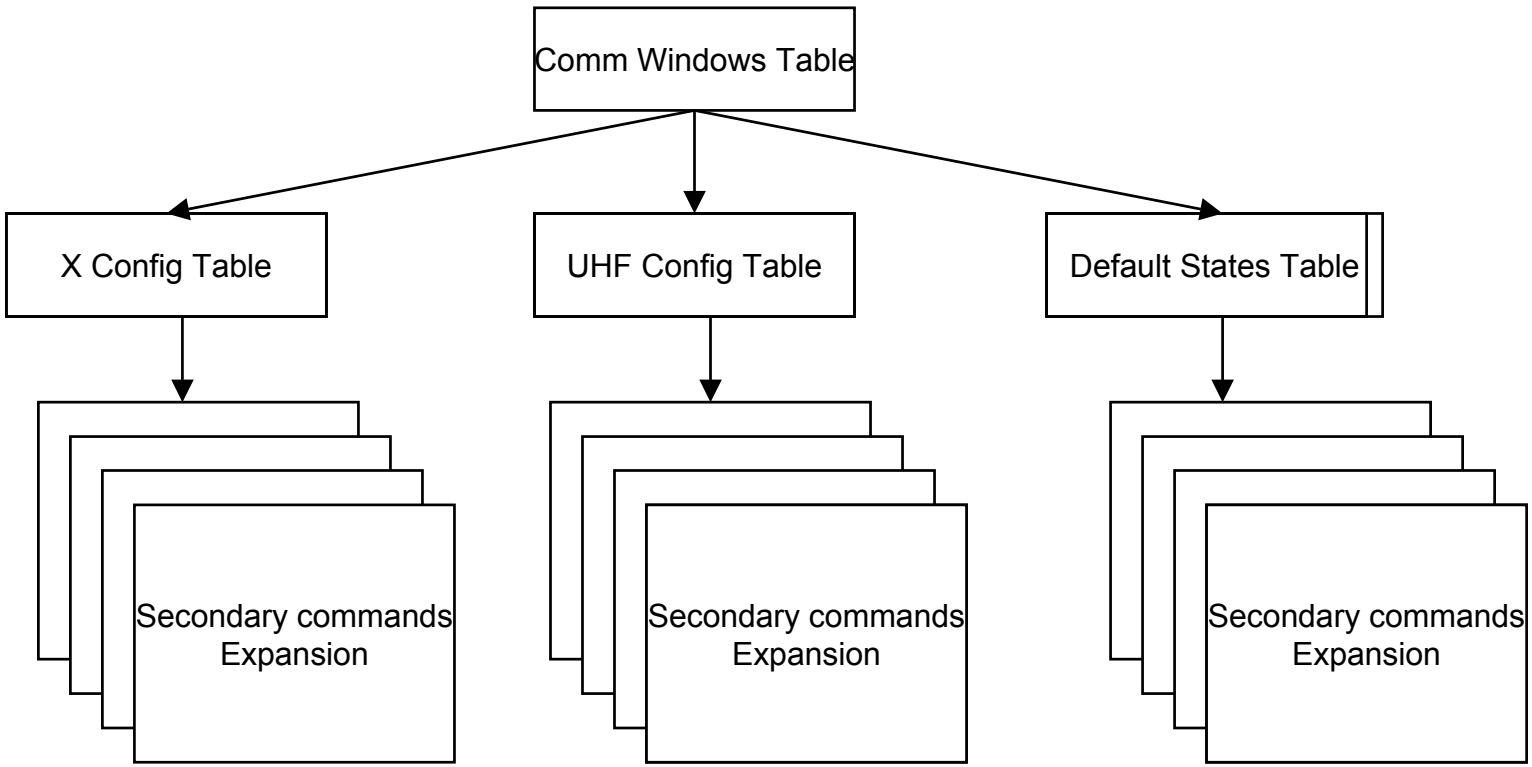
DRCF and DVCF in MER Uplink Process

(Modified from A. Amador's ORRR presentation)

- **DRCF: SIS-ENG005-MER**
- **DVCF: SIS-ENG008-MER**



Comm Behavior Modeling for Sequence Generation

- **Comm Windows Behavior:**
  - **Creates SATF templates in SEQGEN database:**
    - Original design plan has 3 SATF templates
      - **X-Band table**
      - **UHF table**
      - **Default States table**
    - Final implementation has 13 templates
      - **Config tables, high priority tables, default tables, and others**
  - **Models Telecom primary commands (SMF)**
  - **Models Telecom secondary commands (SMF)**
  - **Models DSN Ground Events (SMF)**
  - **Generates DSN Keywords (SMF and Pef_display)**

Modeling - Telecom/Comm Window