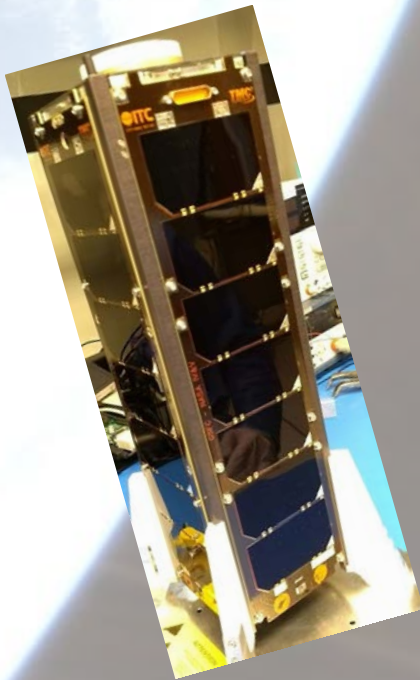


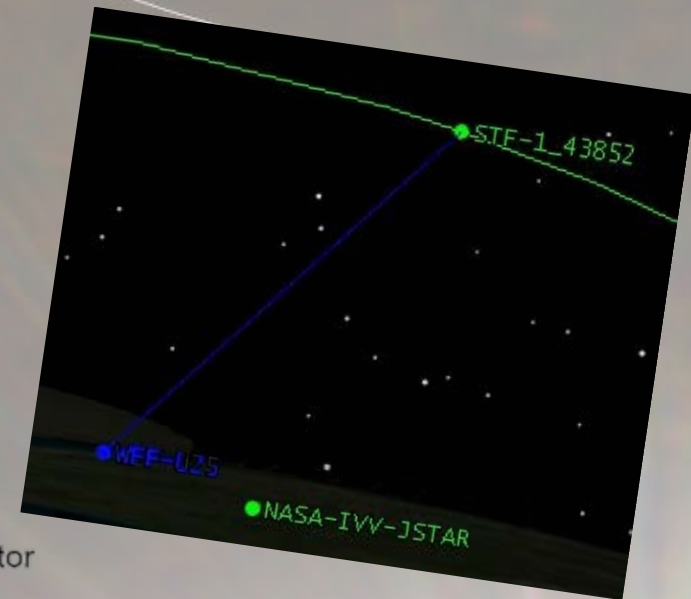


STF-1 Ground Operations

Automating the Planning, Scheduling, Assessment and Data Processing/Reduction for a Small Satellite



Mark Suder
Systems Engineer
TMC Technologies
NASA's IV&V Program





NASA IV&V JSTAR/ITC – Who we Are

And now, for something completely different

- NASA – National Aeronautics and Space Adm.
 - NASA's Software IV&V Program

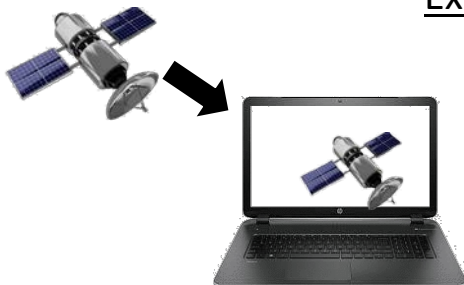


- Software Independent Verification and Validation +
- Primarily NASA, also a few closely related organizations/missions
- Ensuring primarily NASA Class A Mission Success since 1993
- Full Development Lifecycle – Software (and related System) Requirements, Design, Code, Test, AI&T, etc.



• JSTAR/ITC

- JSTAR (see logo); ITC = Independent Test Capability, the personnel team for the lab (sometimes used interchangeably)
- Experts in **software only simulation of hardware** and hardware emulation
 - » Especially, but not limited to, CPU instruction set simulation so flight binary executables can execute on commodity hardware
 - » Also emulation of flight peripherals, buses, etc.
 - » And more...





Background

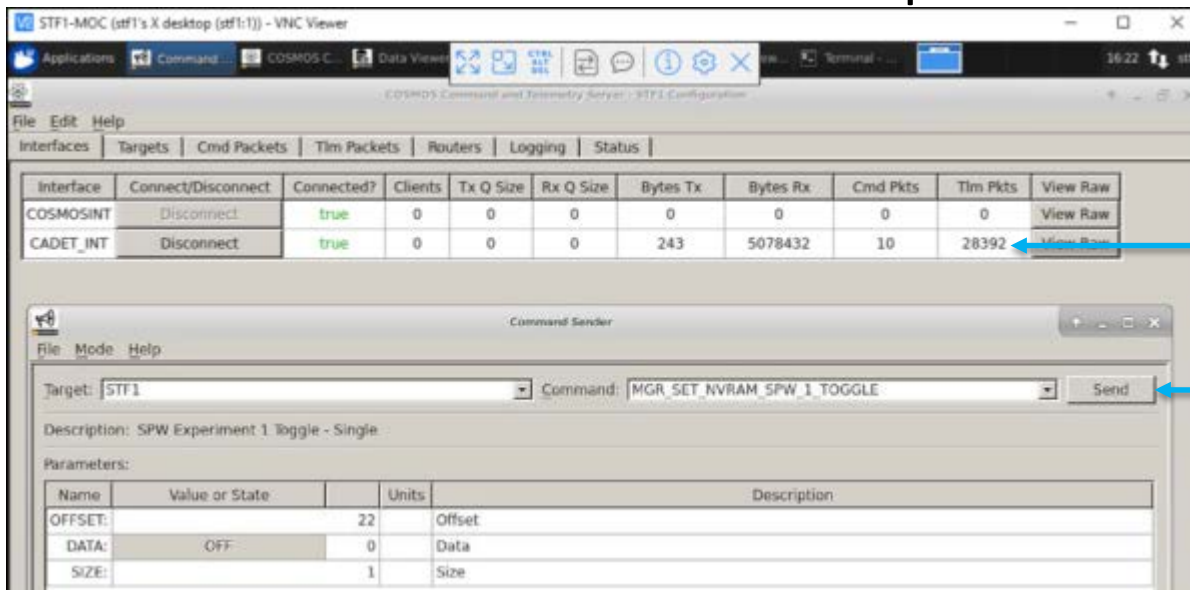
- STF-1 = Simulation-to-Flight 1
 - 3-U CubeSat
 - Primary Objective: Development of NOS³ Spacecraft Simulator
 - Secondary Objectives: 4 Science Payloads
- 12/16/2018 Launch; 12/19/2018 First Contact
 - Now what?
 - How do we efficiently and effectively operate?





Pre-Launch Existing – Command and Control

- Ball Aerospace COSMOS:
 - Development:
 - Telemetry and Command Definitions created/used
 - Transitioned as-is into Operations



Stats on Cmd/Tlm Sent/Received;
Comforting to see Tlm #s Increase

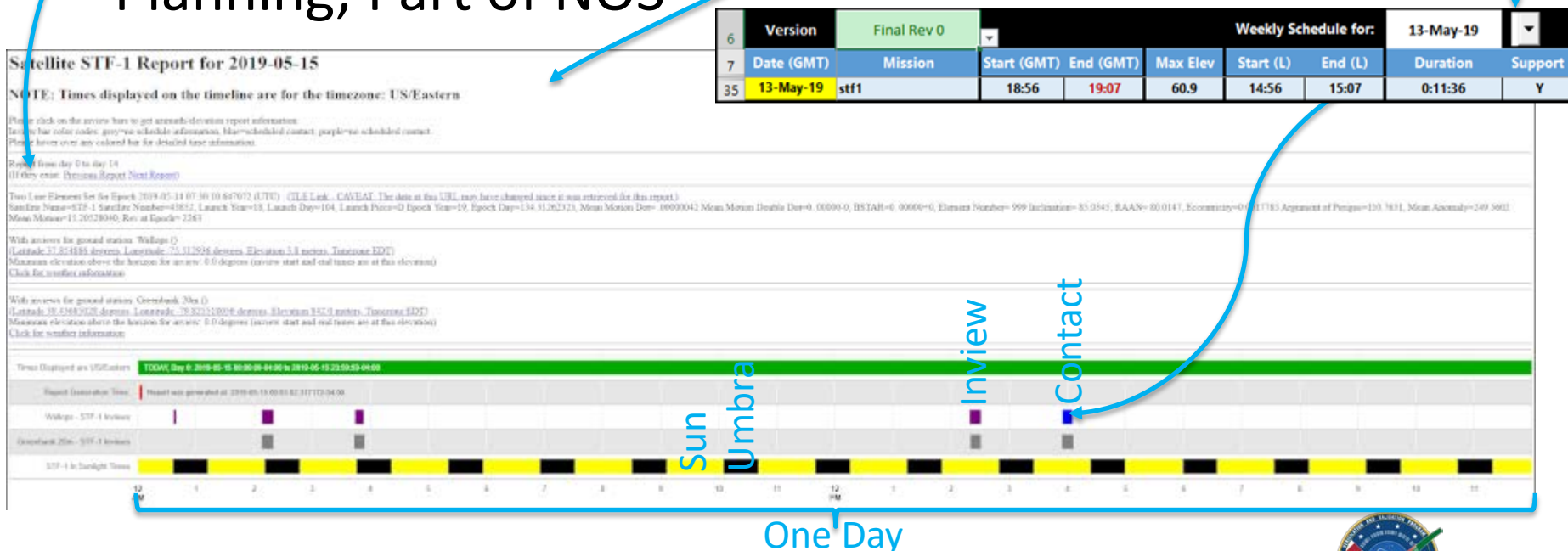
Command Sender to
Send Commands





Pass Planning

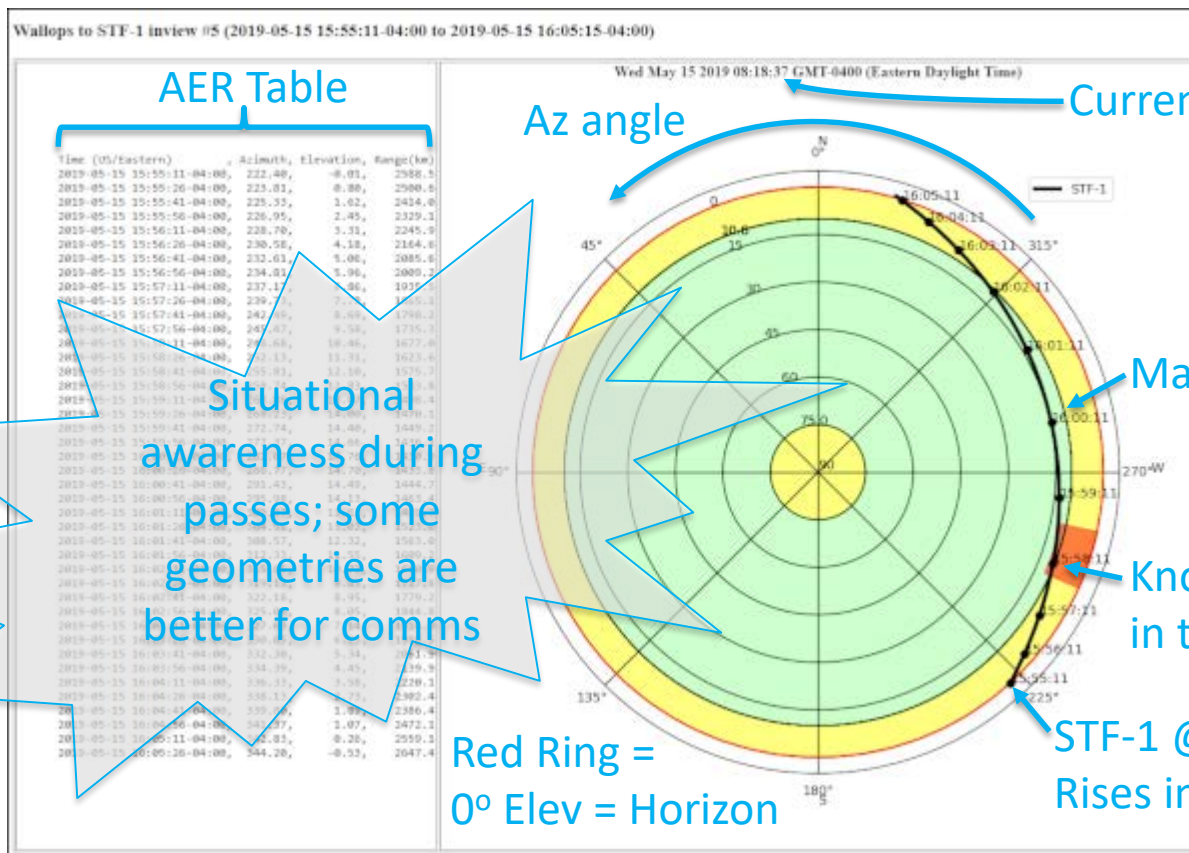
- NASA Wallops UHF Antenna – Shared Resource, Weekly Spreadsheet Schedule
- STRATCOM TLEs
- Feed homegrown tool – Orbit Inview and Power Planning, Part of NOS³





Pass Support

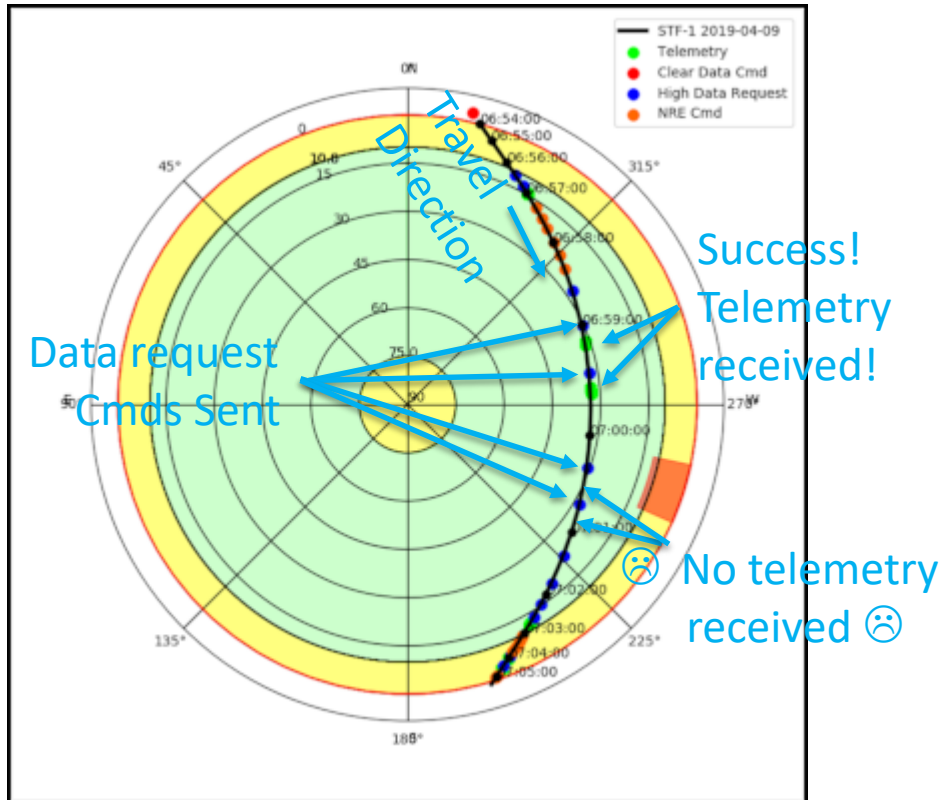
- Azimuth/Elevation/Range Table and Graph





Automated Post-Pass Assessment

- Similar az/el plot; Assess pass cmd/tlm times



- Slack Messages: 

```
RECEIVED_TIMEFORMATTED,VIDIODE,PDM_STATES_EXP  
3 14:59:32.769,8.2628173828125,0,0  
3 14:59:34.815,8.253817558288574,0,0
```

Voltage
Good 👍





Supporting Science

- Binary telemetry to CSV:
- Sharing via Google Drive:

Name	Date modified	Type	Size
2019-04-26T03_29_30-04_00_CFE_ES_HkPacket_t.csv	4/29/2019 10:31 AM	Microsoft Excel C...	174 KB
2019-04-26T03_29_33-04_00_CFE_EVS_Packet_t.csv	4/29/2019 10:31 AM	Microsoft Excel C...	23 KB
2019-04-26T03_29_40-04_00_CFE_EVS_TlmPkt_t.csv	4/29/2019 10:31 AM	Microsoft Excel C...	333 KB
2019-04-26T03_29_45-04_00_CFE_SB_HKMsg_t.csv	4/29/2019 10:31 AM	Microsoft Excel C...	98 KB

2019-05-14T14_55_43-04_00_EPS_hk_tlm_t.csv - Excel

as Data Review View Developer Help PDFsam Enhanced 5 Creator

_1_DB_1_TEMP

	U	V	W	X	CZ	
IE	VIDIODE	I3V3DRAW	I5V3DRAW	BOARD_TEMP	BATTERY_0_DB_1_TEMP	BAT
688	8.235818	0.0185857	0.033189	13.33331299	9.702865601	
688	8.235818	0.0185857	0.033189	12.96121216	9.702865601	
688	8.235818	0.0185857	0.033189	12.58911133	9.702865601	
688	8.226817	0.0185857	0.033189	11.10070801	10.06164551	
688	8.235818	0.0185857	0.034516	11.10070801	9.702865601	

- Generated calendar
 - Science cmds sent:
 - Science telemetry received:

April 2019		
Tue	Wed	Thu
2	3 2019-04-03T19_43_23-04_00_CSEE_exp1_tlm_t.csv 2019-04-03T19_44_45-04_00_GPS_Time_Tlm_t.csv	4
9 CSEE_1 CSEE_2	10 CAM	11 2019-04-11T08_33_35-04_00_CAM_Esp_tlm_t.csv
		12 201 201





NASA IV&V JSTAR/ITC – What we Do

And now, for
something completely
different

- STF-1 +
- Software Only Simulation
 - NOS³
 - Human Exploration
 - Science Missions



ARISTOTLE
ADVANCED RISK REDUCTION INTEGRATED SOFTWARE TEST &
OPERATIONS TH-PROGRAM LIGHTWEIGHT ENVIRONMENT

GS2

S3



JIST



WISP
WISPR-RESEARCH SIMULATION PLATFORM

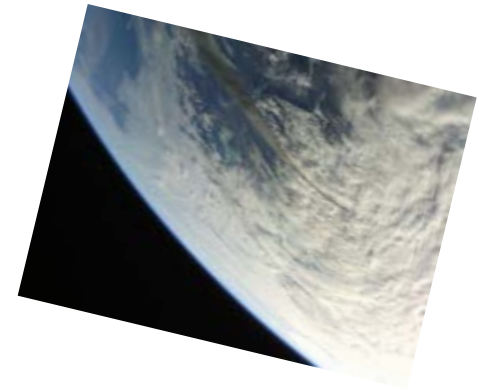




Thank You!



Questions?



mark.suder@tmctechnologies.com

<https://www.nasa.gov/centers/ivv/about/index.html>

<https://www.nasa.gov/centers/ivv/jstar/JSTAR.html>

www.stf1.com

www.nos3.org

