



Forecasting AFSCN Utilization using STK/Scheduler

Byron Hays ÿ Tom DeLaCruz ÿ Andrew Carlile – Scitor Corporation
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Overview

- 50 SW/XPY Background
- AFSCN Background
 - User set
 - Unique Issues
- Analysis and Forecasting Methodology
 - Legacy Modeling and Simulation Tools
 - Advanced Modeling and Simulation Tools
- Summary

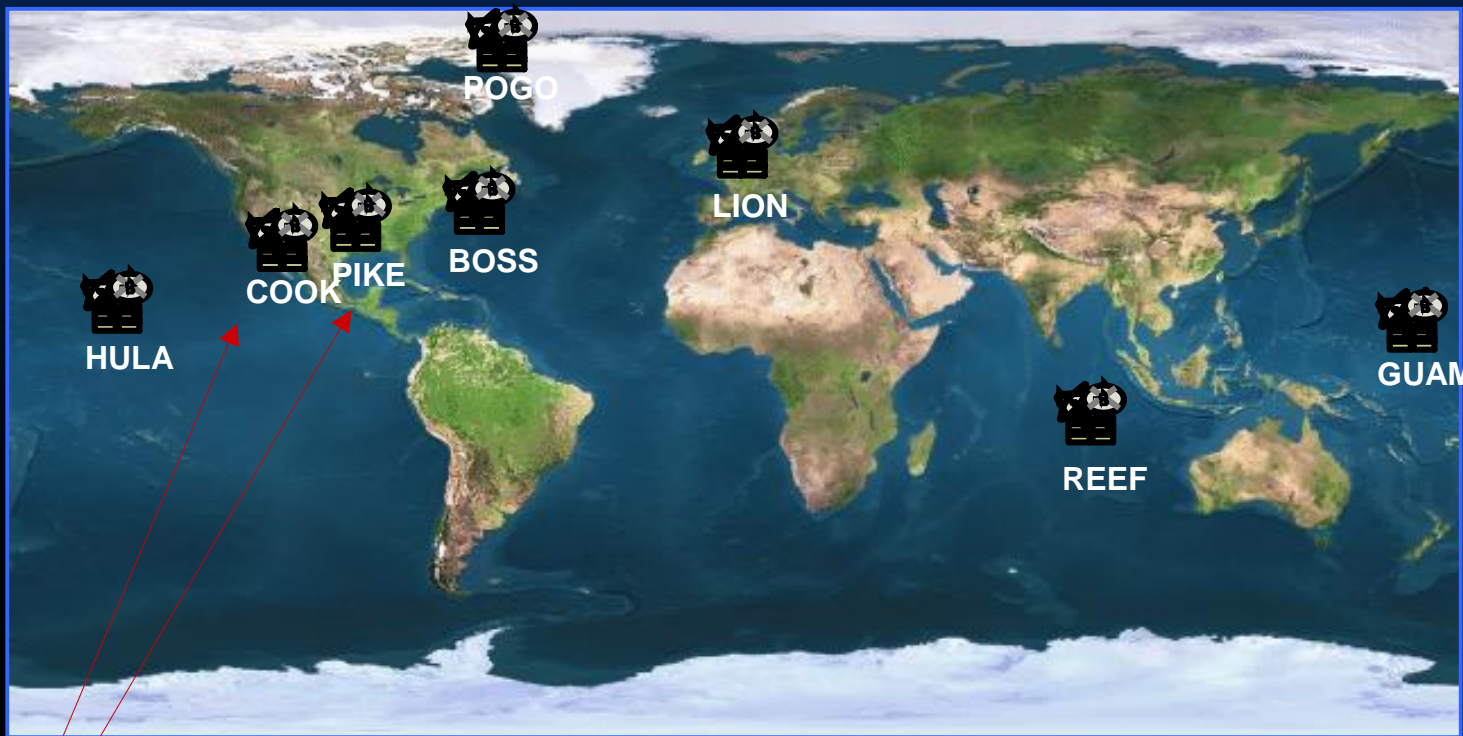


50 SW/XPY Background



- 50th Space Wing Studies and Analysis Branch located at Schriever AFB in Colorado Springs
- Forecast near term and future utilization of the Air Force Satellite Control Network (AFSCN) from current to ten years out
- Perform network antenna coverage and capacity analysis
- Studies and Analyses for:
 - AFSCN Executive Council – Network Management
 - SATOPS Operations WG – National Security Space Architect
 - Air Force Space Command – Requirements and Operations Analysis
 - AFSCN User Community

AFSCN Background



Network Operations Centers
Schriever AFB
Onizuka AFS

www.stk.com

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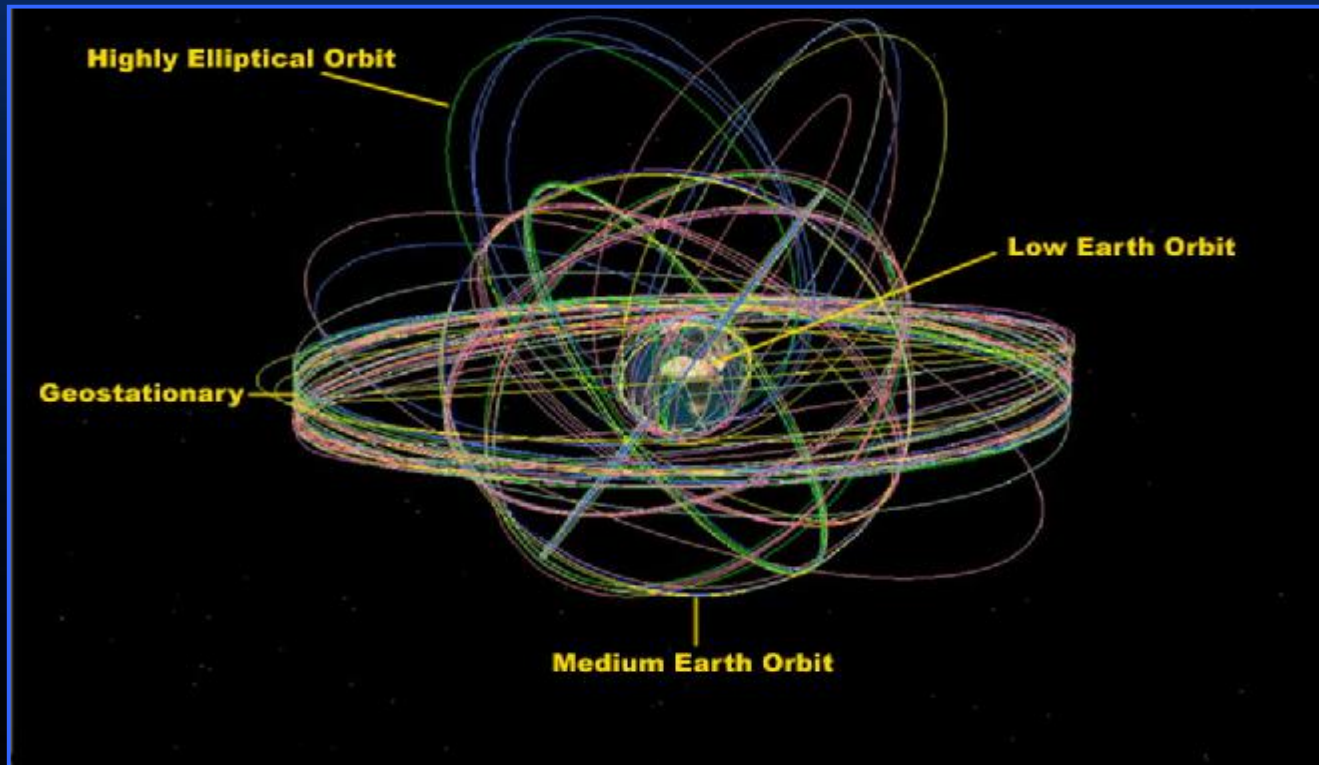
AFSCN Background cont.



- Issues facing the AFSCN Today
 - High Utilization – Conflicts for Resources
 - Eastern (5) vs. Western (10) Hemisphere AFSCN Locations
 - 500+ AFSCN Daily Scheduled Activities and growing
 - Integration w/ other networks (NASA, NOAA, Navy, other AF, etc.)
 - ISCN Concept
 - Antenna Upgrades
- Current User Set
 - GPS
 - MILSATCOM
 - DSP
 - T&E
 - DMSP
 - Launch
 - Navy
 - NASA
 - NOPS

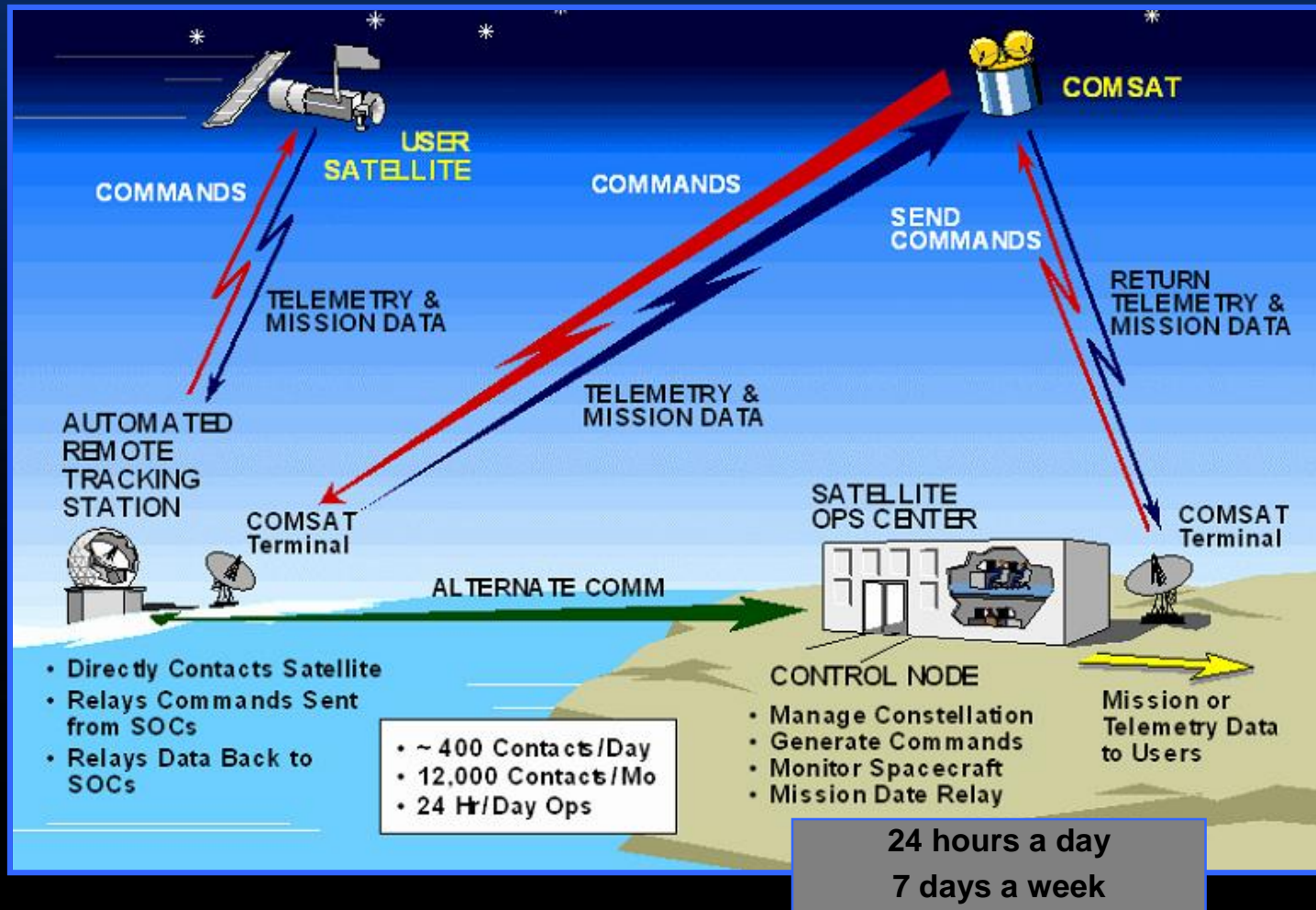


Orbits Supported by AFSCN



AFSCN SUPPORTS ALL EARTH ORBITS

AFSCN Operations Concept



AFSCN Scheduling Problem Statement



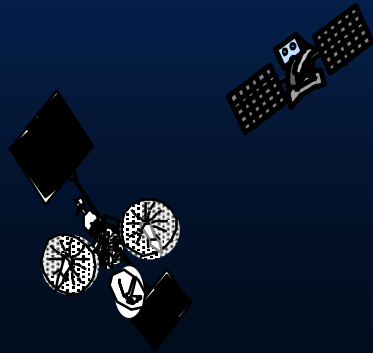
- Forecasting Problem:
 - Approximately 530 Daily Task definitions
 - Each Simulation run over a 2 to 4 week time period
 - Minimize unused network time
 - Completed Optimized product with 99%+ assigned (based on resource availability)
 - Each Simulation run should complete within 15-30 minutes Max



Scheduling Methodology



Resource consumer



Orbit parameters

Orbit propagation

Support requirements (pre-/post-pass, contact duration, frequency, location/equipment constraints)

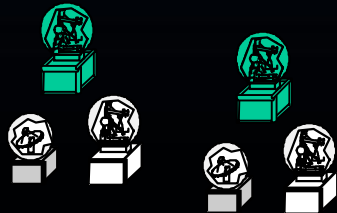
Visibilities

Schedule requests

Scheduling engine

Utilization statistics

Elastic resource



Location

Effective capacity (planned/unplanned downtime)



Analysis and Forecasting Legacy Tools

- AFSCN Scheduling Program (ASP)
 - “...validated, community accepted tool used...since 1990 for modeling...AFSCN capacity.” (Ref 2)
 - Primary tool – $\approx 2\%$ overall AFSCN Ue prediction error (actual vs. predicted)
 - Software maintained by SMC/CW and the Aerospace Corp.
 - ASP Benefits:
 - Proven tool
 - Fast; Quick Look capability
 - Additional tools
 - SNAP
 - SMAT
 - Logical Decisions for Windows

Analysis and Forecasting Legacy Tools



ASP GUIs

Microsoft Excel - ASP.XLS

File Edit View Insert Format Tools Data Quicksheet Window Help

100% Arial

C15

Version 2002.01.15.0

Specify Inputs for ASP Run

Update ASP Database

Execute ASP

Import ASP Run Output

ASP Subsystem Execution Selection

Check Subsystems to Execute:

- Visibility
- Scheduling
 - Automatic
 - Interactive
- Information Retrieval

OK

Cancel

Analysis and Forecasting Legacy Tools



Antenna Utilization and Effective Antenna Utilization Percentages		
	Effective	Effective
Antenna ID	Antenna Utilization	Antenna Utilization
TTSA	52.49	61.77
TTSB	50.17	57.82
TTSC	48.26	55.73
TCSA	85.26	97.96
TCSB	85.33	96.6
NHSA	70.13	87.57
NHSB	80.46	93.35
CTSA	73.63	86.58
VTSA	78.42	90.5
VTSB	73.52	86.9
HTSA	68.21	84.12
HTSB	69.05	85.07
GTSA	80.1	94.77
GTSB	76.84	91.93
DGSA	74.41	91.94
FBKA	21.07	21.51
AVG CUE	71.09	84.12

ASP Text based Output Reports

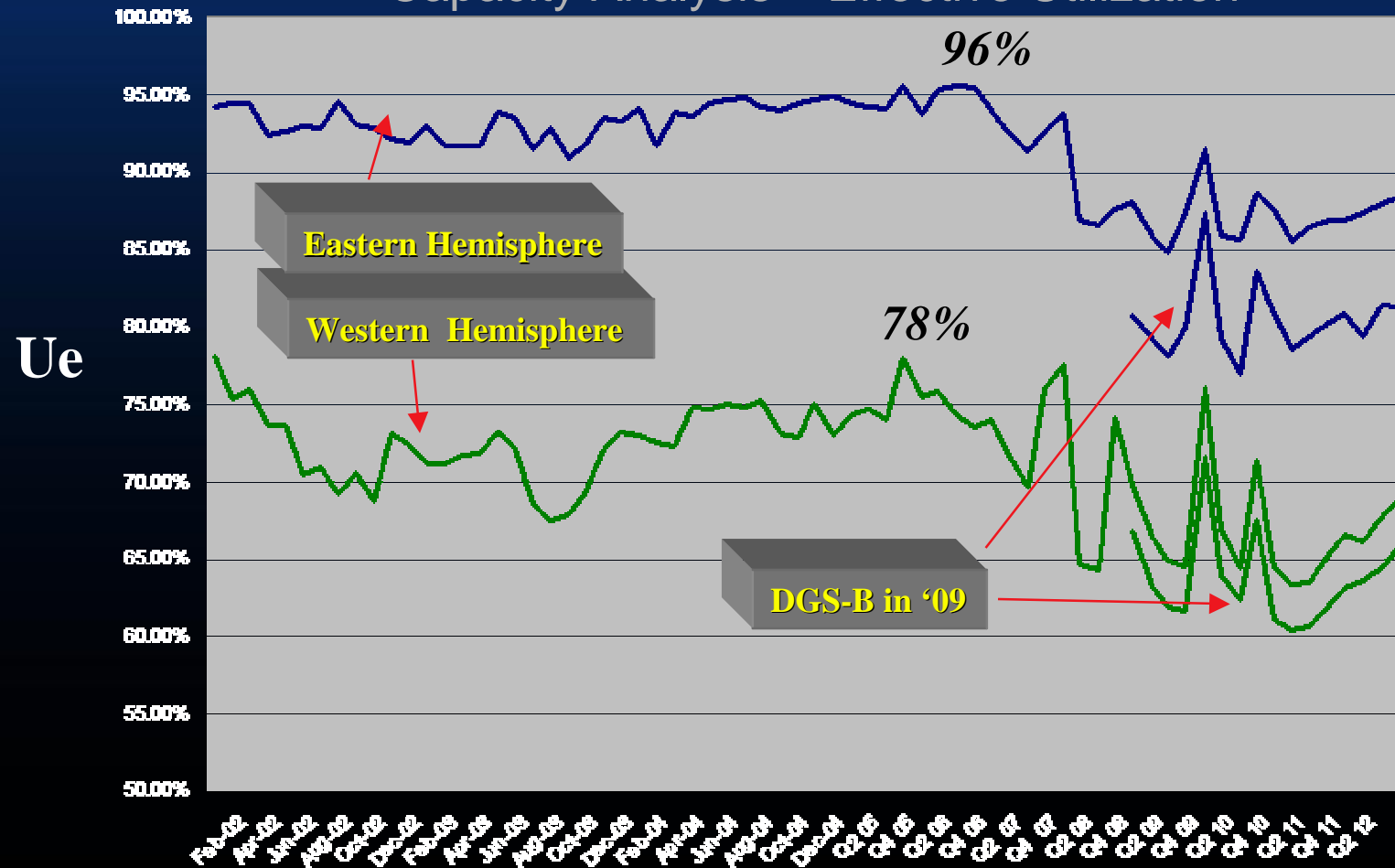
AVERAGE DAILY ANTENNA UTILIZATION (ALL TIMES IN MINUTES)							
Antenna ID	Number of Supports Provided	Number of Conflict Deletes	Setup Time Provided	Pass Time Provided	Excess Capacity Time	Unusable Time	Downtime Provided
TTSA	28.77	0	340.52	387.3	467.75	216.44	28
TTSB	25.55	0	304.75	342.65	527.03	190.57	75
TTSC	27.94	0	326.02	332.88	552.12	192.97	36
TCSA	46.52	0.06	511.65	644.16	25.55	186.64	72
TCSB	47.9	0.16	504.08	640.65	43.24	168.02	84
NHSA	40.1	0.1	434.01	531.83	143.35	286.81	44
NHSB	35.58	0.1	393.05	721.57	82.52	198.86	44
CTSA	34.32	0.1	386.73	617.59	164.34	215.34	58
VTSA	37.58	0.03	436.49	620.76	118.57	192.18	72
VTSB	36.65	0.1	426.43	564.28	159.57	221.72	68
HTSA	38.48	0.16	448.85	465.41	185.42	272.31	68
HTSB	38.9	0.1	453.05	473.33	174.49	271.12	68
GTSA	44.74	0.16	517.49	539.98	63.69	222.84	96
GTSB	43.36	0.1	494	524.45	97.12	236.42	88
DGSA	42.45	0.06	512.2	511.25	93.89	274.66	46
FBKA	14.1	0	109.45	193.94	1107.15	29.45	0



Analysis and Forecasting Legacy Tools



Capacity Analysis – Effective Utilization





Analysis and Forecasting Legacy Tools

- Short Falls of the current tools
 - Limited ability to automate the 10-year Forecasting process
 - No integrated graphics capability
 - Orbit and Schedule
 - Limited Schedule Optimization
 - Limited ability to handle detailed constraint modeling
 - Need greater antenna/site specific resolution
 - Support requirements tied to orbit events, time, locations, etc.
- New Tool Investigation
 - NPAS
 - FTI - SOPSMAN
 - STK/Scheduler



Analysis and Forecasting Advanced Tools

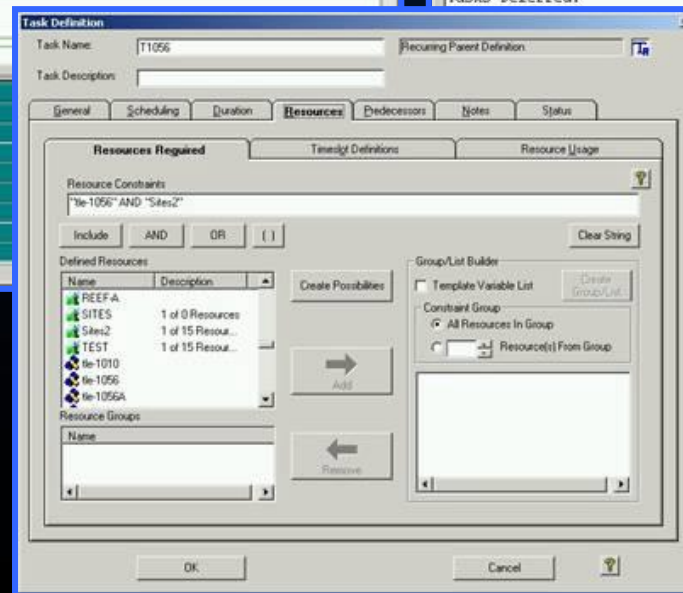
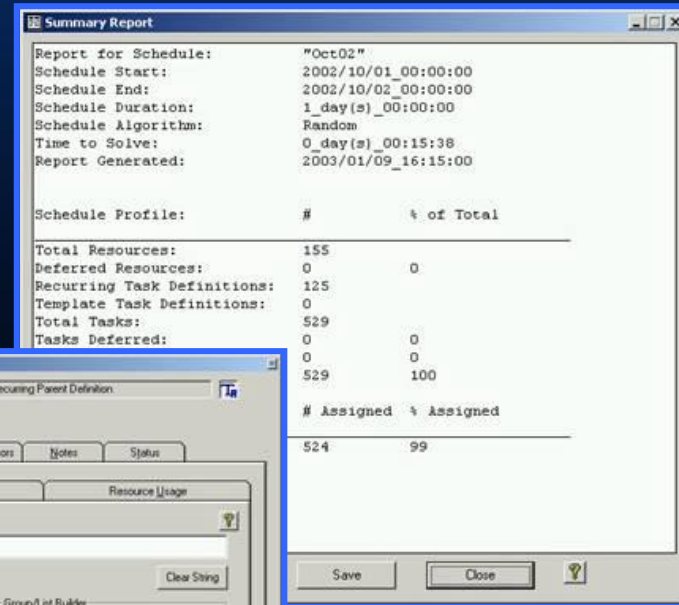
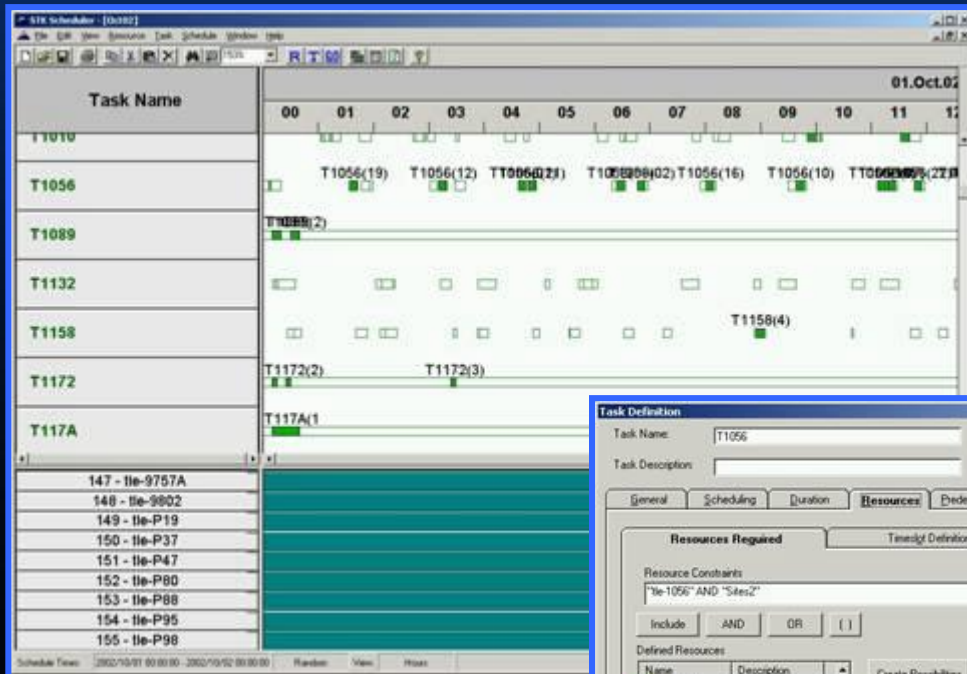


- STK/Scheduler

- XPY's STK Modules: STK/Pro, STK/Comm, STK/Coverage, STK/Connect, STK/Chains, STK/Scheduler
 - First Customer to utilize "official" Air Force Astro Standard DLL (SGP4)
 - Visual Timeline (schedule)
 - Optimized Scheduling Engine
- Integrated with the core STK product
 - Automatically scheduled above 95% of the supports
 - Connect scripting allows efficient automation to be used
 - Interface allows ease of creating constraints to provide greater granularity and accuracy in requirement modeling
 - Potential for enhanced graphic capability
 - Runs completed in minutes vs. hours/days



Analysis and Forecasting Advanced Tools



Analysis and Forecasting Advanced Tools



Visual Schedule

- Identify the Missed Opportunities
- See the Heavy Load
- *Easy to understand!*



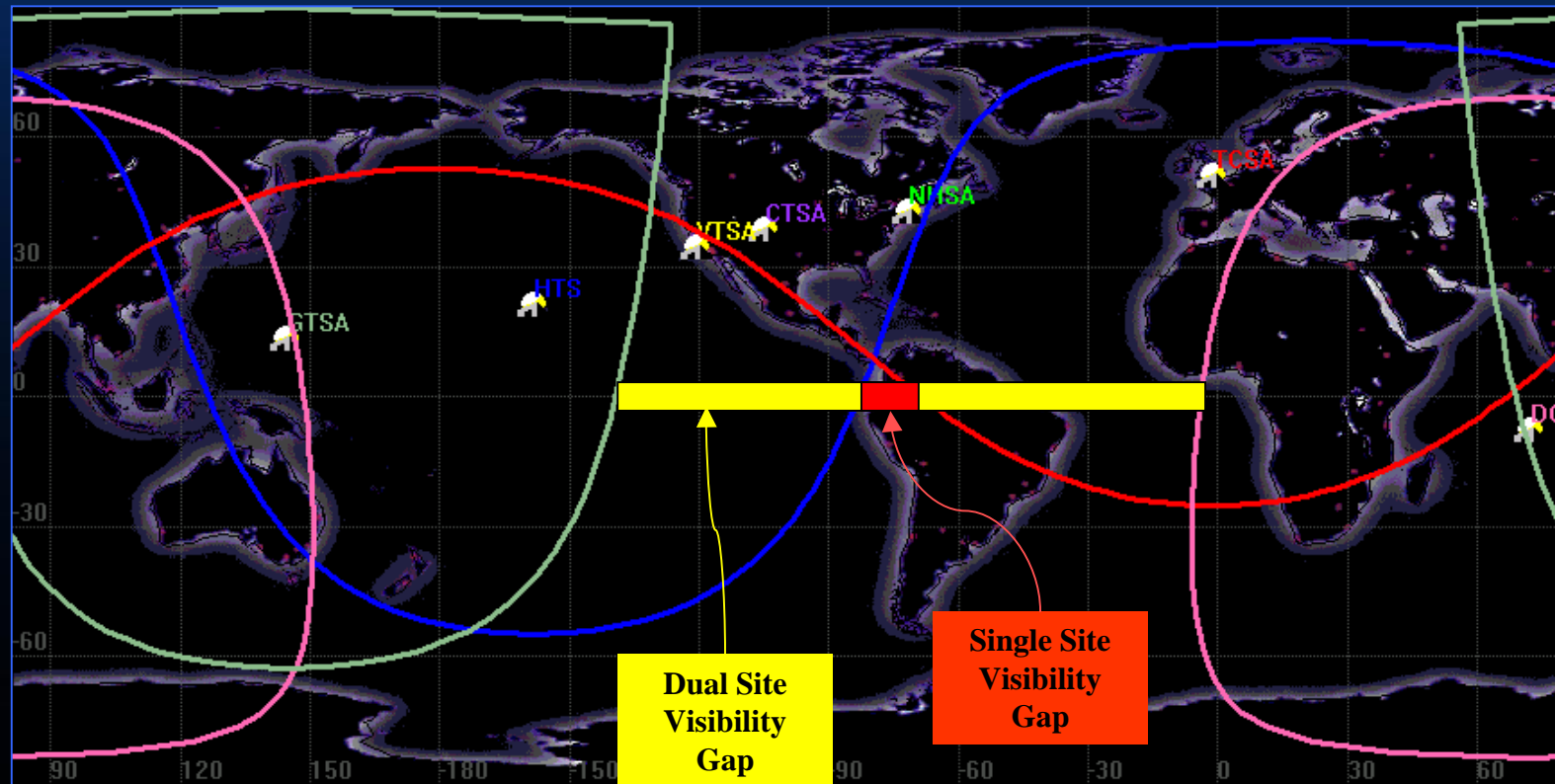
Analysis and Forecasting Advanced Tools



- XPY's STK suite has proven invaluable in communicating orbit and coverage information
 - IMT 2000
 - AFSCN augmentation
 - Coverage Analysis
- We expect STK/Scheduler to provide the same capability for resource utilization within the XPY tool suite



IMT 2000 STK Example

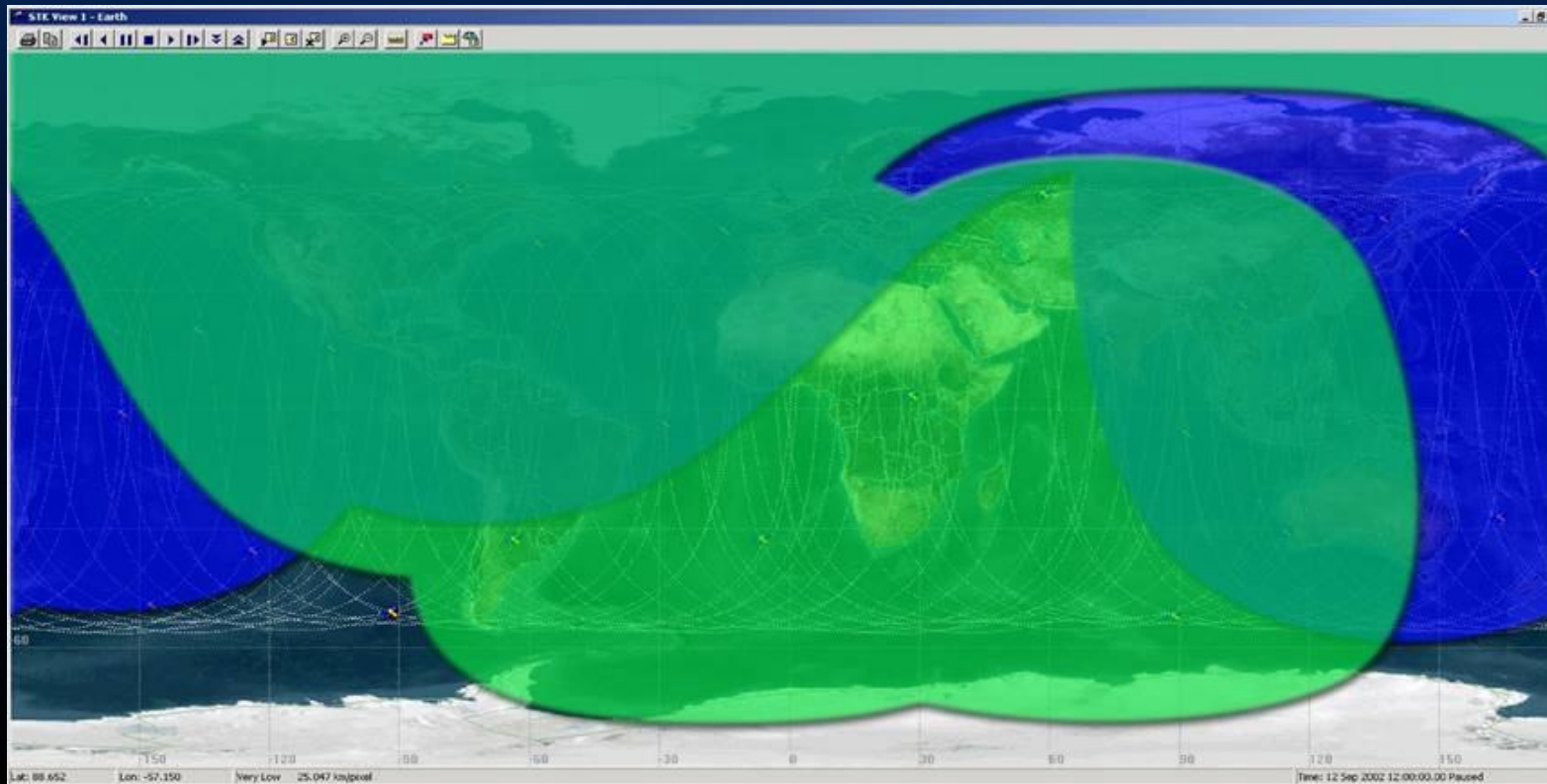


IMT 2000 (NO CONUS SITES) EXAMPLE: Without VTS,CTS or NHS there is a gap in single site visibility from -82 to -68 degrees and a dual site visibility gap from -140 to -3 degrees



AFSCN Augmentation STK Example

Coverage Analysis – AFSCN Augmentation (HULA, BOSS, and GUAM) of ‘Degraded’ GPS Coverage (No Kwajalein)



AFSCN Augmentation  Degraded GPS  Overlap 



Summary

- Legacy Scheduling Tools: ASP
 - Still a crucial part of the toolkit
- STK/Scheduler
 - Very promising
 - Other STK Modules already essential to our modeling capabilities
 - Enhanced satellite constraint & requirement modeling – complex constraints
 - Refined antenna by antenna analysis
 - Other Network resources sharing
 - Promise for comm capacity planning → Consumable resources
 - Visual schedule shows potential in communicating “stress”
 - Connect interface → Automation
 - Outstanding Vendor Interaction & Support
 - Internal Validation pending
 - AFSCN Development & Sustainment contract is currently using STK/Scheduler

