
Automation in Satellite Ground Systems

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Outline

- NOAA Overview
- Survey Results
 - Metrics
 - Best Practices



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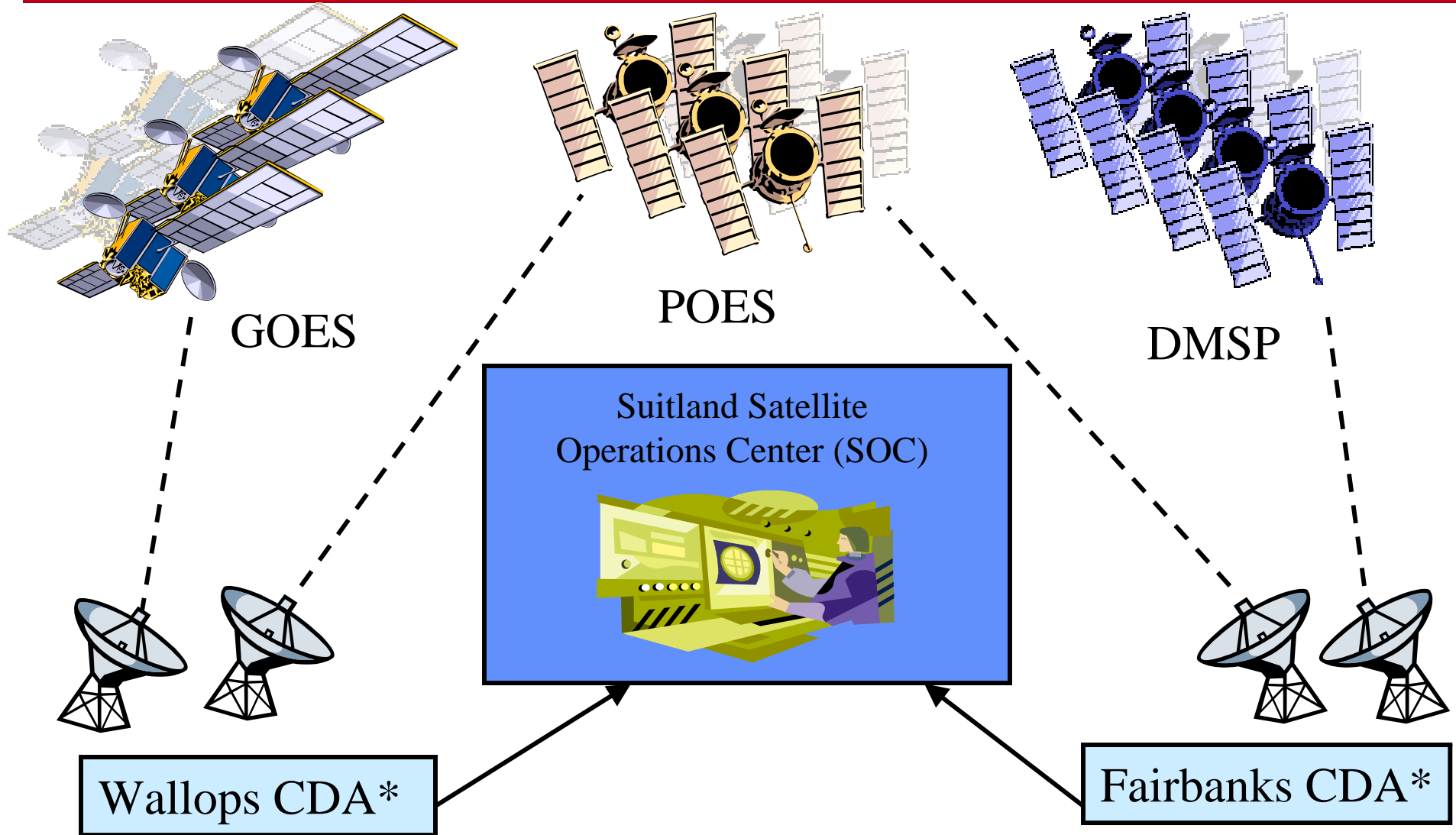
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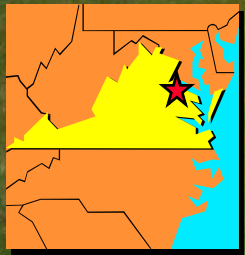
Joy Bush

Overview of NOAA's Satellite Operations

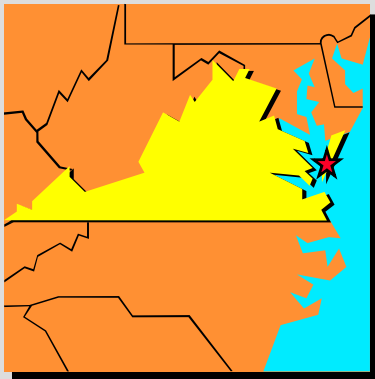
NOAA Satellite Operations



* Command and Data Acquisition



Suitland SOC



Wallops CDA





Fairbanks CDA

Ground Systems Industry Best Practices Survey

Survey Methodology

- Visit civilian government, military, commercial and foreign satellite operations centers
 - Baseline “state of the practice” staffing
 - Collect best practices in automation and business process improvement
 - Collect lessons learned in implementing automation
- Uniquely possible for Aerospace
- Completed site visits Sep 04

Site Visits

Civil (CIV)	Military (MIL)	Commercial (COM)	European (EUR)
NOAA Suitland	GPS	Iridium	Eumetsat
NASA Goddard	DSCS	Datalynx SOC	ESA
CSA	Milstar	Intelsat	CNES
JPL	ESOC	Digital Globe	
NOAA Fairbanks	CERES	Datalynx Poker Flat	
NASA Poker Flat	AFSCN RTS	Raytheon Denver	
NASA Wallops Island	AFSCN Control Center	Public Broadcasting System (PBS)	
NOAA Wallops Island	Multi-mission SOC		
TRMM			
Landsat 7			

Staffing Metrics

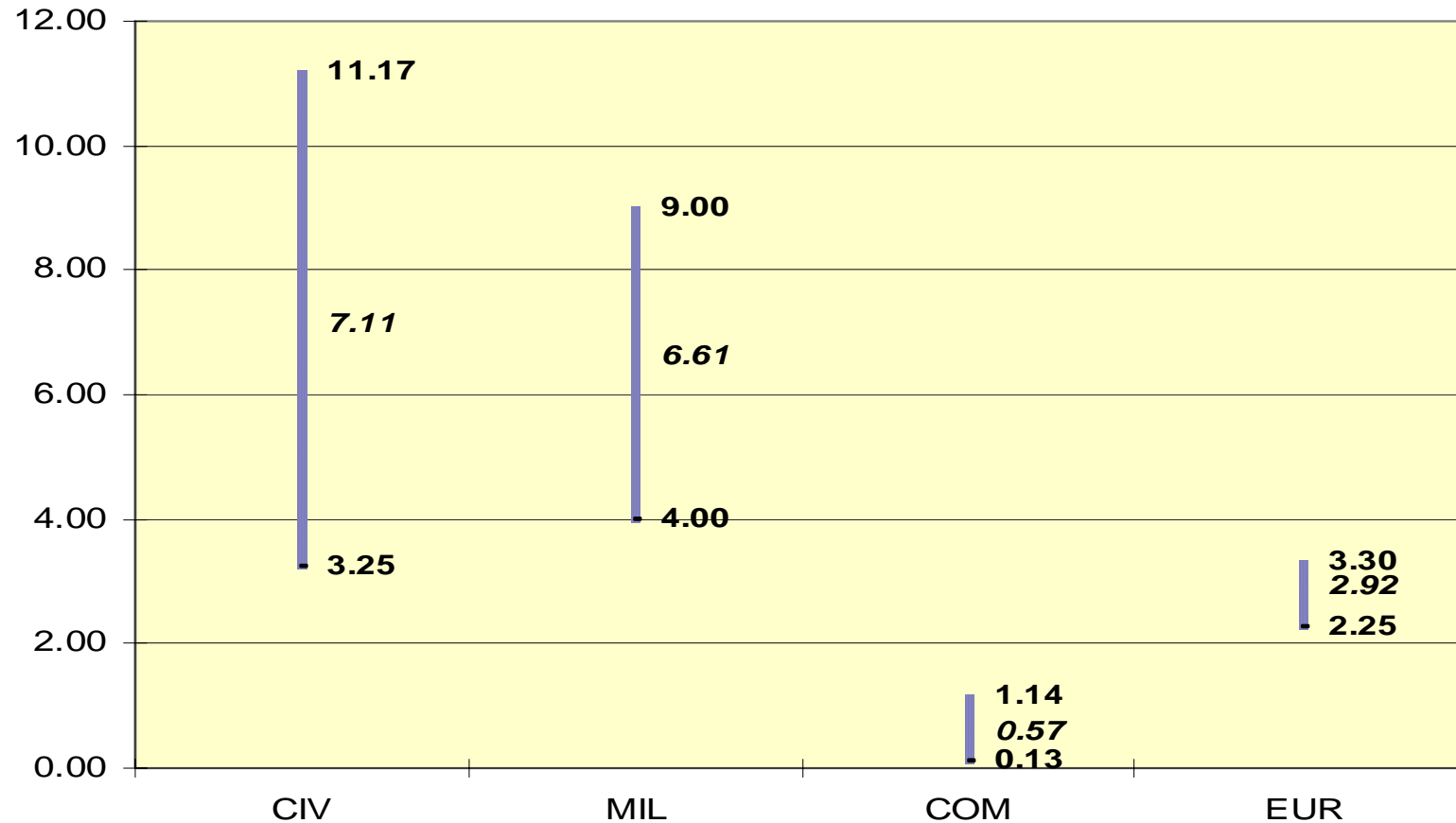
Metrics Background

- How efficient are current satellite operations?
- Selected 3 metrics:
 - RTSs: Staff / antenna
 - SOCs: Staff / satellite
 - Total Systems: Staff / pass
- Metrics chosen to reveal broad trends
 - Major differences between satellite programs make specific comparisons invalid
 - Trends and conclusions must be validated with further analysis

What Counts as Satellite Operations?

- Staffing that is included:
 - Operators
 - Engineers
 - Schedulers / Orbital Analysts
 - Ground communications & networks
 - Hardware technicians
 - Software developers
 - Training staff
 - Shift supervisors
- Staffing that is not included:
 - Mission-related
 - Administrative
 - Building maintenance
 - Security
 - Management

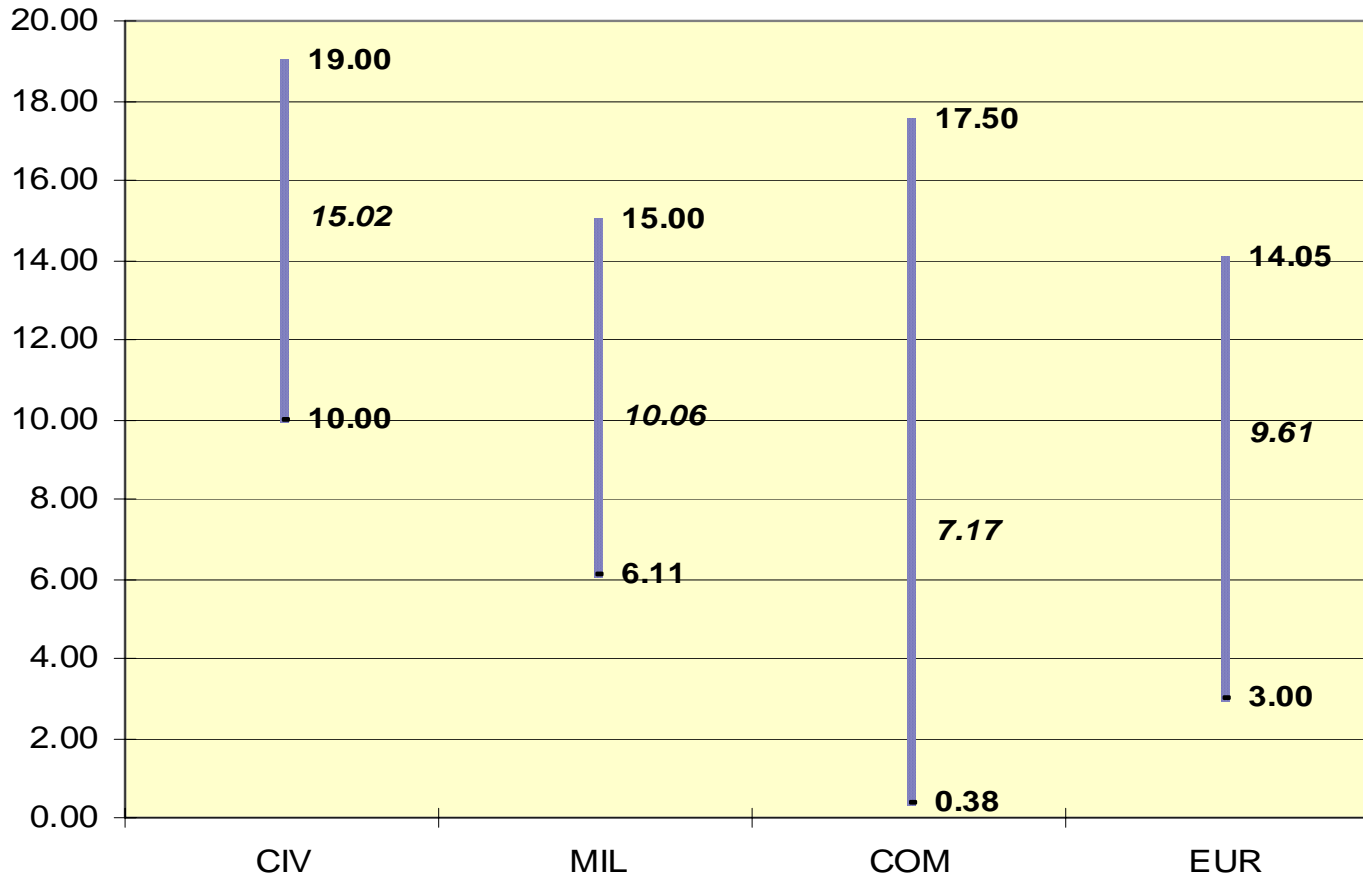
RTS Metric: Staff / Antenna



Major differences between CIV/MIL and COM/EUR sites

- Most Commercial / European sites have little or no operations staff

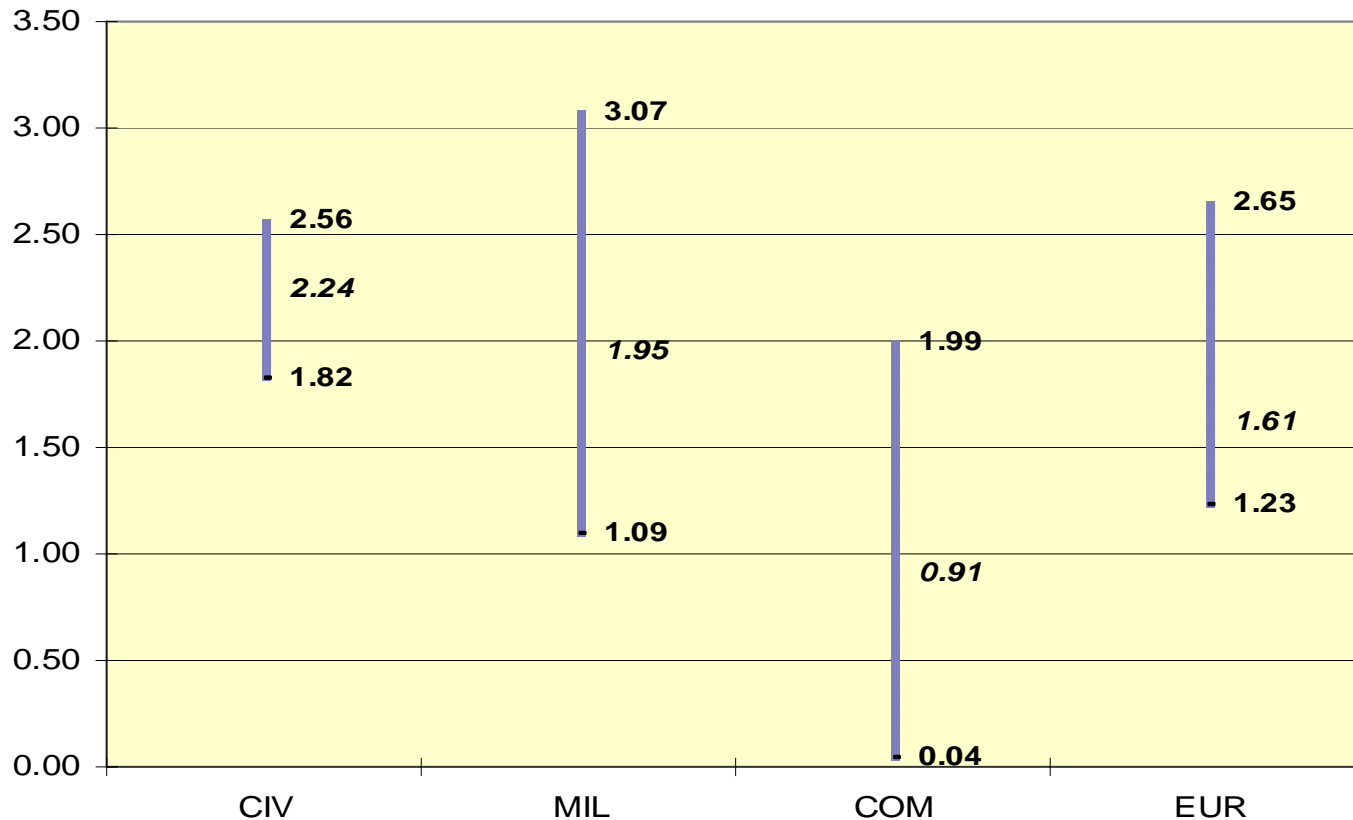
SOC Metric: Staff / Satellite



CIV programs generally have the most SOC staff.

Note: COM and EUR numbers include remote RTS management.

Total Program Metric: Staff / Pass



Difference narrows when total program work & costs are considered.
CIV programs are still the most inefficient on average.

Conclusions

Conclusions

- An efficient satellite program can operate with unmanned RTSES, no more than 1 SOC operator per satellite, and overall staffing of ~1 staff / pass
- Automation is feasible and increasingly adopted by commercial and European programs
- There is no evidence that automation increases risk
- Future satellite programs need architectures to support remote monitoring & control, SOC automation, and COTS/GOTS software

*For a more detailed paper describing this work,
Please email Scott Turner (srt@aero.org)*