6

# DMSP BLOCK SIX RISK REDUCTION

# DMSP/POES PAYLOAD ACCOMODATION STUDY TIM #1

**17 SEPTEMBER 1993**

*Prepared for:*

**USAF/AFMC/CIB**
**SPACE & MISSILE SYSTEMS CENTER**
LOS ANGELES, CALIFORNIA

**CONTRACT F04701-91-C-0068**

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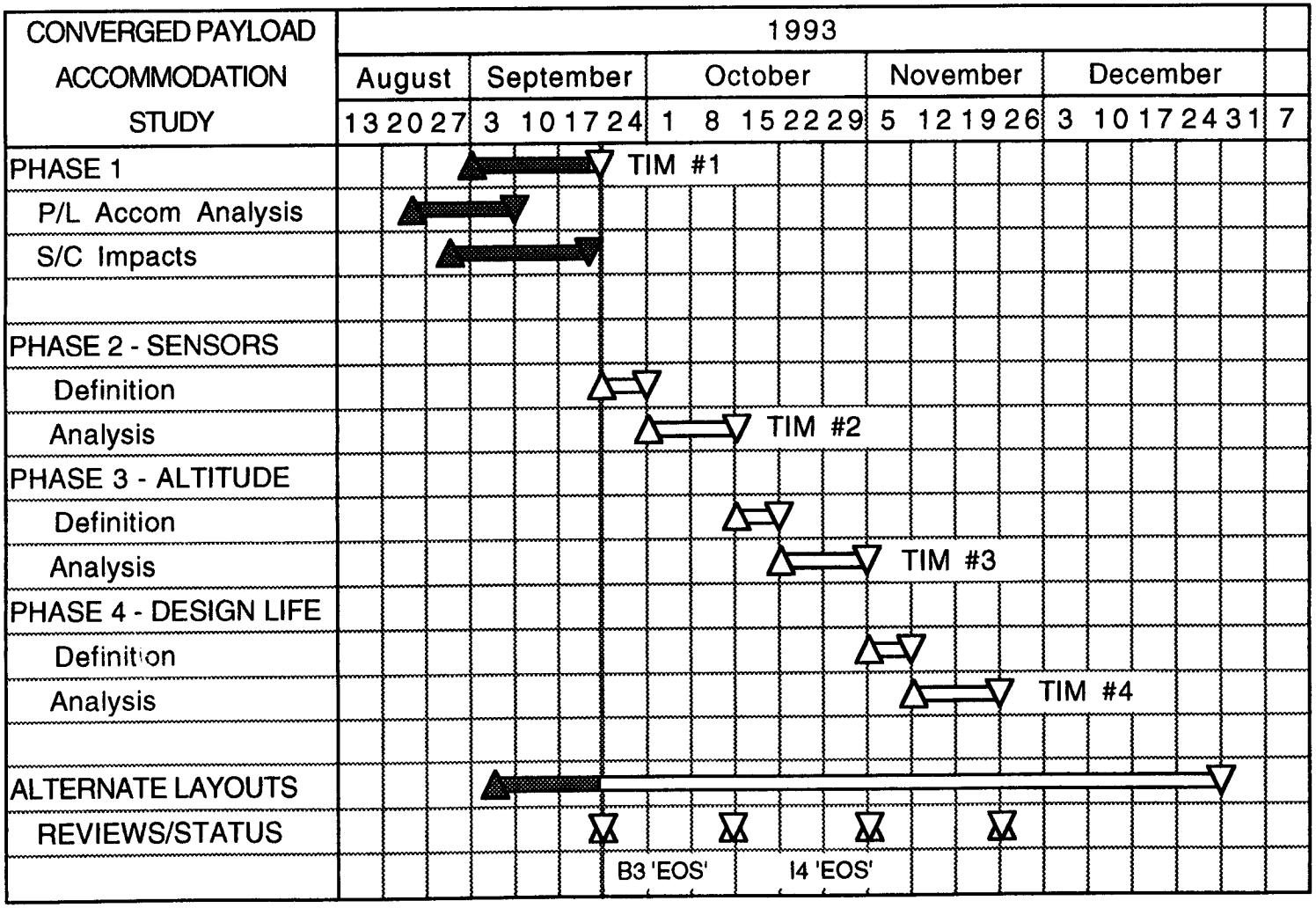
# 6 PLANNING SCHEDULE



# 6 PAYLOAD ACRONYMS

| SENSOR TYPE | SENSOR | ACRONYM |
|---|---|---|
| V and IR RADIOMETER | Operational Multi-Channel Imager Suite - Modified<br>Moderate-Resolution Imaging Spectroradiometer | OMIS<br>MODIS |
| MICROWAVE | Advanced Microwave Sounding Unit - A<br>Microwave Humidity Sounder<br>Microwave Imager / Sounder Suite<br>Multifrequency Imaging Microwave Radiometer | AMSU-A<br>MHS<br>MISS<br>MIMR |
| INFRARED SOUNDING | Atmospheric Infrared Sounder<br>Interferometer Thermal Sounder | AIRS<br>ITS |
| OZONE | Solar Back-Scatter Ultraviolet Monitor | SBUV |
| RADIATION BUDGET | Clouds and Earth's Radiant Energy System | CERES |
| SPACE ENVIRONMENT | Advanced Vector Magnetometer<br>Auroral Bounding Imaging Sensor - Ultraviolet<br>Retarding Potential Analyzer - Driftmeter<br>Global Positioning System<br>Neutral Atmosphere Daytime Ionosphere Sensor<br>Medium Energy Particle Spectrometer | AVM<br>ABIS-UV<br>RPA-D<br>GPS<br>NADIS<br>MEPS |
| COMMUNICATIONS | Search and Rescue<br>Data Collection and Location System | S&R<br>ARGOS |
| OTHER | Miniature Satellite Threat Reporting System | MSTRS |

DMSP BLOCK SIX

# 6 CONVERGED SYSTEM ALTERNATIVE CONFIGURATIONS

| CONFIG & S/C | A | | | B | | | C | | | D | | | E | | | F | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SENSOR ↓ | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 |
| OMIS | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ |
| MHS | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ |
| AMSU-A1 | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ |
| AMSU-A2 | | | | | | | | | | | ▬ | | | | ▬ | | ▬ | |
| ARGOS | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ |
| S&R | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ |
| MISS | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | | ▬ | ▬ | ▬ | | ▬ | | ▬ |
| SESS | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | | ▬ | ▬ | ▬ | | ▬ | | ▬ |
| MSTRS | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | | ▬ | ▬ | ▬ | | ▬ | | ▬ |
| AIRS | | | | ▬ | | ▬ | ▬ | | ▬ | | | ▬ | | | | ▬ | | ▬ |
| ITS | ▬ | | ▬ | | | | | | | | | | ▬ | | | | | |
| SBUV | | | ▬ | | | ▬ | | | ▬ | | | ▬ | | | ▬ | | | ▬ |
| MIMR | | | | | | | | | | | | | | | | | | |
| SEM | | | | | | | | | | | ▬ | | | | ▬ | | ▬ | |
| MODIS | | | | | | ▬ | | | | | | | | | | | | ▬ |
| IASI | | | | | | | | | | | ▬ | | | | ▬ | | ▬ | |
| CERES | | | | | | ▬ | | | | | | | | | | | | ▬ |
| *LAUNCH* | D | D | D | D | D | A | D | D | D | D | E | D | D | D | E | D | E | A |

1 = 0530 BIRD
2 = 0930 BIRD
3 = 1330 BIRD
— ASCENDING NODE

D = MLV/3 DELTA CLASS
A = ATLAS 2AS CLASS
E = EUROPEAN LAUNCH

# 6 CONVERGENCE TIM #1 TASKS

- DMSP BASELINE REVIEWED
  - ESTABLISH BASELINE REFERENCE
- PAYLOAD MATRICES ANALYZED
  - SIX 3-BALL CONSTELLATIONS
  - ~~THREE~~ SIX UNIQUE CONFIGURATIONS
  - DELTA MLV; EXCEPT ONE INCLUDING EOS ON ATLAS
- SPACECRAFT LAYOUTS AND IMPACTS
  - THREE BASIC CONFIGURATIONS WITH MINOR VARIATIONS
  - DMSP / NOAA CONFIGURATIONS A & C (ITS / AIRS)
  - DMSP / NOAA / EOS CONFIGURATION B3
- INTER-PAYLOAD ISSUES
  - DRIVERS - SPACE, FOV'S, WEIGHT, STABILITY

# 6 KEY DRIVERS

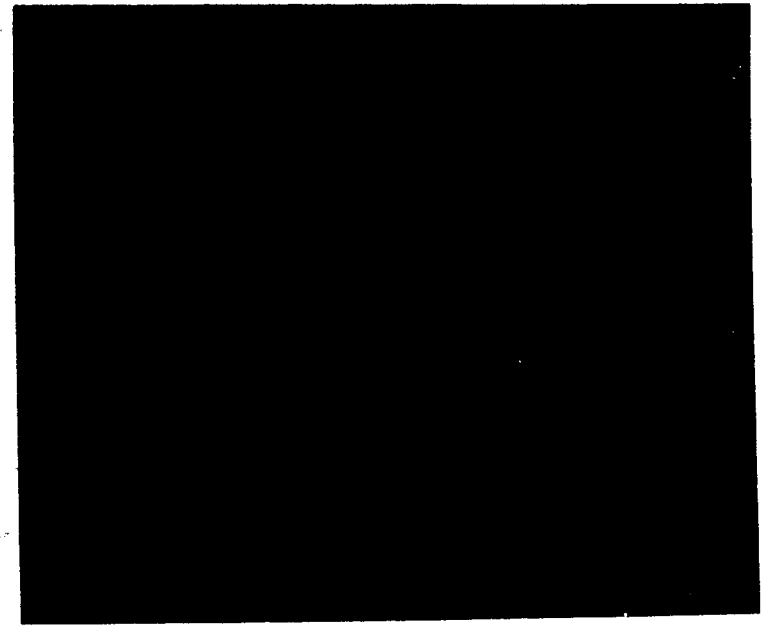
- **SENSORS**
  - DATA RATES
  - DATA STORAGE - UNCOMPRESSED
  - TOTAL SIZE, WEIGHT, POWER, FOV, ETC
  - PERFORMANCE VS ALTITUDE VARIATIONS
  - LIFETIME
- **DATA ROUTING & RETRIEVAL**
  - TOTAL BANDWIDTH - DOWNLINKS, RELAYS, INGEST
  - TOTAL DATA QUANTITY
  - DATA QUALITY
  - GROUND STATIONS (X-BAND)
- **SPACECRAFT**
  - STOWED PACKAGING FOR DELTA FAIRING (10' x 312")

6

# DMSP BLOCK 6 BASELINE

DMSP BLOCK SIX

# 6 LOCKHEED COMMON ENVIRONMENTAL SPACECRAFT



## KEY FEATURES:

- LARGE SENSOR FOV AREA
- MODULAR SENSOR GROWTH
- BUS - 7 YEAR DESIGN LIFE
- 3 SIGMA POINTING
  - KNOWLEDGE < 0.01 DEG
  - CONTROL <0.02 DEG
- NO CRITICAL SINGLE POINT FAILURES
- MLV LAUNCH
- ORBIT ADJUST CONTROL
- NAVY OPTION PROVISIONS

PAGE 10 IS EXEMPT FROM RELEASE AND IS REPLACED WITH THIS PAGE.

DMSP BLOCK SIX

# 6 [redacted] & BLOCK 6 INTEGRATION

- ATTITUDE DETERMINATION & CONTROL
- NATURAL ENVIRONMENT SURVIVABILITY
- ELECTRICAL POWER AND CONDITIONING
- SATELLITE COMMAND, CONTROL
- TELEMETRY PROCESSING

- ON-ORBIT PROPULSION
- SGLS UP/DOWN LINKS
- BUS FDAC & AUTONOMY
- [redacted]
- BOOSTER INTERFACE

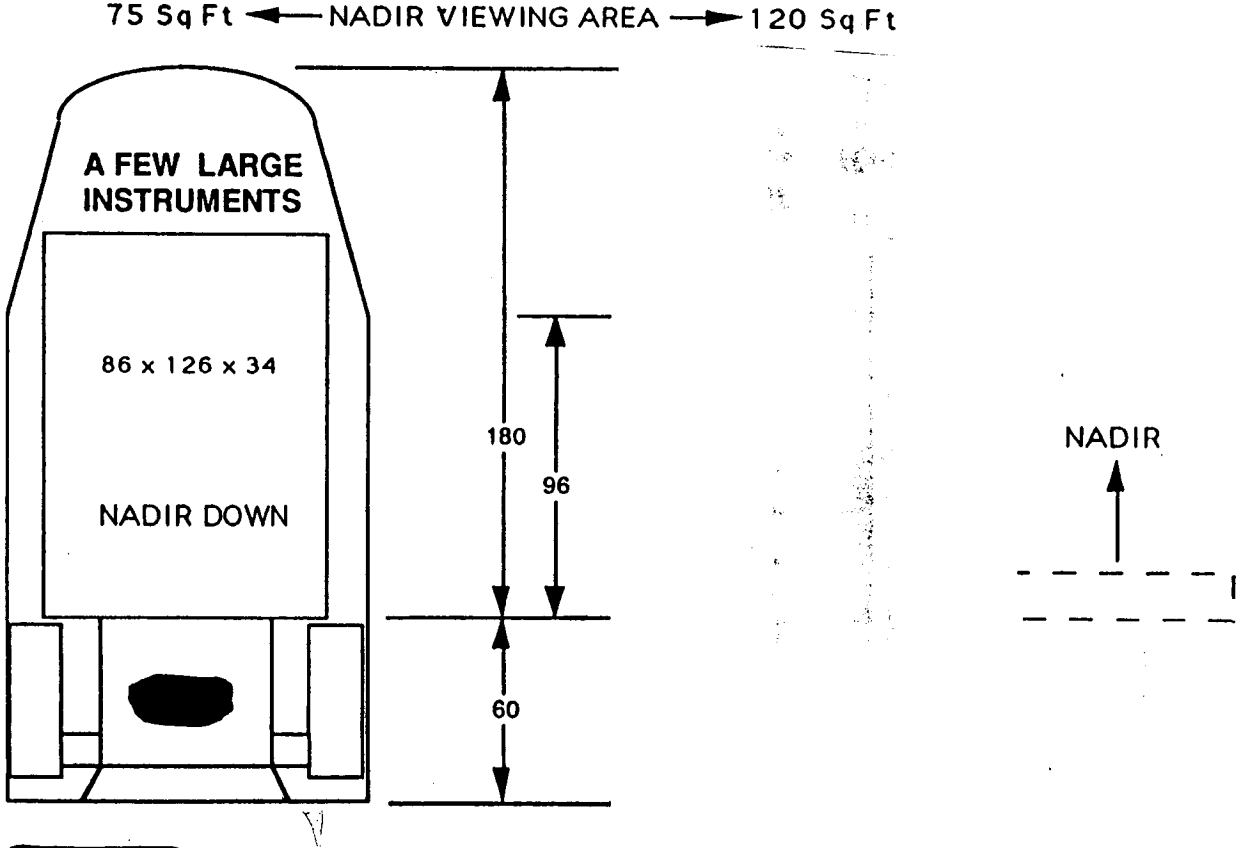
- PAYLOAD [redacted] INTERFACE
- MISSION SENSORS, S&F AND SDC
- DATA PACKETIZER & SSM
- MISSION DATA PROCESSING SOFTWARE

- MISSION DATA DOWNLINKS
- 60 DAY AUTONOMY,
- THREAT SURVIVABILITY
- PROGRAM SPECIFIC FDAC
- PROGRAM SUPPORT EQUIPMENT

DMSP BLOCK SIX

# [redacted] MAXIMIZES NADIR VIEWING

6




THE [redacted] APPROACH PROVIDES 60% MORE INSTRUMENT MOUNTING SPACE THAN A [redacted] STRUCTURE USING LOCKHEEDS LOW COST SPACECRAFT [redacted]

DMSP BLOCK SIX

# 6 BASELINE SPACECRAFT REQUIREMENTS

| PARAMETER | SPACECRAFT KEY REQUIREMENTS |
|---|---|
| ALTITUDE | 450 NM / 650 NM (TBR) |
| ORBIT INCLINATION | 98.7 / 100.4 DEGREES (SUN SYNCHRONOUS) |
| ASCENDING NODE | ALL-BETA DESIGN (2 S/C CONSTELLATION) |
| SENSORS | BASIC: OMIS, MISS, SESS<br>NAVY OPTIONS: DSCAT, DALT |
| OMIS MAPPING ACCURACY | 4 KM (EDGE OF SCAN) |
| LIFE | 6 YEAR MMD, 7 YEAR LIFE (TBR) |
| SAFEMODE | S/C TO SURVIVABLE MODE |
| SURVIVABILITY | PER CLASSIFIED RQMTS |
| RELIABILITY | NO SINGLE POINT FAILURES |
| AUTONOMY | 60 DAYS W/O GROUND INTERVENTION |
| GROWTH | PROVISIONS FOR 25% PAYLOAD GROWTH |

DMSP BLOCK SIX

# PRIMARY MISSION SENSORS CHARACTERISTICS

6

| SENSOR | LENGTH (IN) | WIDTH (IN) | HEIGHT (IN) | FOOTPRINT (SQ FT) | WEIGHT (LBS) | POWER (W) | DATA RATE (KBPS) | FOV (DEG) |
|---|---|---|---|---|---|---|---|---|
| OMIS | | | | | 289 | 195 | 2800 | NADIR +70 -56 XTRK |
| SENSOR | 53 | 24 | 21 | 9.2 | 195 | | | |
| ELECTRONICS | 16 | 16 | 8 | 3.4 | 70 | | | |
| POWER SUPPLY | 12 | 8 | 8 | 0.6 | 24 | | | |
| MISS | | | | | | | | |
| • MISS | | | | | 220 | 175 | 40 | EL = 56 AZ = ± 70 |
| SENSOR | 22 dia. | | 22 | 3.4 | | | | |
| ANTENNA | 80 | 80 | | | | | | |
| | | | | | 509 | 370 | | 2 |

# 6 SESS CHARACTERISTICS

| SENSOR | LENGTH (IN) | WIDTH (IN) | HEIGHT (IN) | FOOTPRINT (SQ FT) | WEIGHT (LBS) | POWER (W) | DATA (KBPS) | FOV (DEG) |
|---|---|---|---|---|---|---|---|---|
| • GPSR: | | | | | | | | |
| RCVR/PROC | 10 | 9 | 5 | 0.6 | 7 | 6 | 2 | |
| OSCILLATOR | 7 | 4 | 3 | 0.2 | 3 | 6 | | |
| ANTENNAS (5) | 5 | 6 | 5 | 0.2 | 5 | | | Omni |
| • MEPS | 9 | 6 | 6 | 0.3 | 9 | 5 | 1.2 | 8x128 Z |
| • RPA-D | 9 | 10 | 10 | 0.6 | 25 | 11 | 2 | 120 DOF |
| • ABIS - UV | 10 | 22 | 13 | 1.5 | 18 | 7 | 3 | 10x100 N |
| • DOS | 8 | 6 | 12 | 0.3 | 13 | 6 | 0.31 | Omni |
| • NADIS | 18 | 12 | 13 | 1.5 | 18 | 7 | 1 | Limb±5 |
| • AVM: | | | | | | | | |
| SENSOR | 4 | 3 | 3 | 0.1 | 1 | | | Omni |
| ELECTRONICS | 6 | 6 | 2 | 0.2 | 2 | 1 | 0.3 | |
| BOOM | 40 | 3 dia | | | 20 | | | |
| | | | | | 121 | 49 | | 11 |

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# 6 DMSP / FSAT CAPABILITIES

| ELEMENT | DMSP REQUIREMENTS | FSAT CAPABILITIES |
|---|---|---|
| SMS | MLV, <5000LB, STABLE, SENSOR RQMTS | MLV,6000LB P/L,PRECISION PLATFORM |
| EPS | BUS ALLOCATED 800W, | BUS USES 660W, |
| | 3.3 KW SINGLE SOLAR ARRAY | UP TO 5 KW PER SOLAR ARRAY WING |
| ADCS | 3 SIG DEG: KNOWLEDGE=.025, CTR=.05 | KNOWLEDGE = .01, CONTROL = .02 |
| PS | ORBIT ADJUST <150LB, MANEUVER | UP TO 1000LB, MANEUVER |
| CCT | SGLS (CMD/TLM), P/L DATA LKS | SGLS (CMD/TLM) |
| OBP | BUS & SENSOR PROCESSING | 1750A BUS PROCESSOR |
| TS | ALL BETA TEMPERATURE CONTROL | ALL BETA DESIGN FOR BUS |

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DMSP BLOCK SIX

# SATELLITE WEIGHT SUMMARY

6

| Item 4/93 | Weight with Contingency (lbs) | Contingency (lbs) |
|---|---|---|
| Structures & Mech. | 1098 | 126 |
| Propulsion | 114 | 8 |
| Electrical Power | 1070 | 138 |
| Attitude Determination & Control | 231 | 12 |
| Thermal Control | 133 | 21 |
| On-Board Processing | 180 | 25 |
| Command, Control & Communications | 167 | 29 |
| S&F and SDC | 137 | 22 |
| Survivability | 18 | 3 |
| Bus Dry Weight | 3148 | 384 |
| Mission Sensors | 638 | 123 |
| Sensor Growth (25%) | 159 | 31 |
| Satellite Dry Weight | 3945 | 538 |
| Propellant | 95 | 0 |
| Loaded Sat Weight | 4040 | 538 |

REF: EM1015A, MAR '93

DMSP BLOCK SIX

# SATELLITE POWER SUMMARY

6

| Item 4/93 | Full Sun (W) | Eclipse (W) | Safemode (W) |
|---|---|---|---|
| OMIS | 195 | 195 | 20 |
| MISS (One Unit) | 201 | 201 | 20 |
| SESS | 56 | 56 | 7 |
| Propulsion | 3 | 3 | 8 |
| Electrical Power | 51 | 56 | 36 |
| Attitude Determ. & Control | 213 | 213 | 30 |
| Thermal Control | 106 | 195 | 150 |
| On-Board Processing | 150 | 150 | 167 |
| Command, Control & Comm. | 114 | 114 | 44 |
| Survivability | 18 | 18 | 18 |
| S&F and SDC | 98 | 98 | 0 |
| Satellite Total | 1205 | 1299 | 540 |
| Sensor Growth Margin (25%) | 113 | 113 | 12 |
| Total With 25% Growth (INCLUDES CONTINGENCY) | 1318 | 1412 | 552 |

SOLAR ARRAY - APPROX 3.3KW (BOL)

REF: EM1016A, MAR '93

# 6 SURVIVABILITY

- REQUIREMENTS
  - "SPACECRAFT, OMIS, MISS AND SESS WILL MEET DMSP SURVIVABILITY REQUIREMENTS PER DMSP SPEC"
  - → LMSC DERIVED REQUIREMENTS ANALYZED AND ALLOCATED TO DMSP SUBSYSTEMS AND PAYLOADS
  - → SURVIVABLE CONCEPTS ARE DEVELOPING
  - MSTRS ARE INCLUDED AS PART OF CONVERGED P/L
  - → WEIGHT, FOV, AND POWER ACCOMMODATED
- ISSUES
  - SURVIVABILITY PROGRAMS ARE SUCCESSFUL WHEN IMPLEMENTED AT A SYSTEM LEVEL (NOT PIECE PART)
  - DERIVED REQUIREMENTS MUST BE ALLOCATED TO NON-SURVIVING SENSORS TO MINIMIZE SECONDARY EFFECTS
    - PREVENT OUTGASSING AND CONTROL CONTAMINATION
    - CONTAIN FAILURES AND DAMAGE

**SURVIVABILITY IS AN END-TO-END SYSTEM ISSUE**

# 6

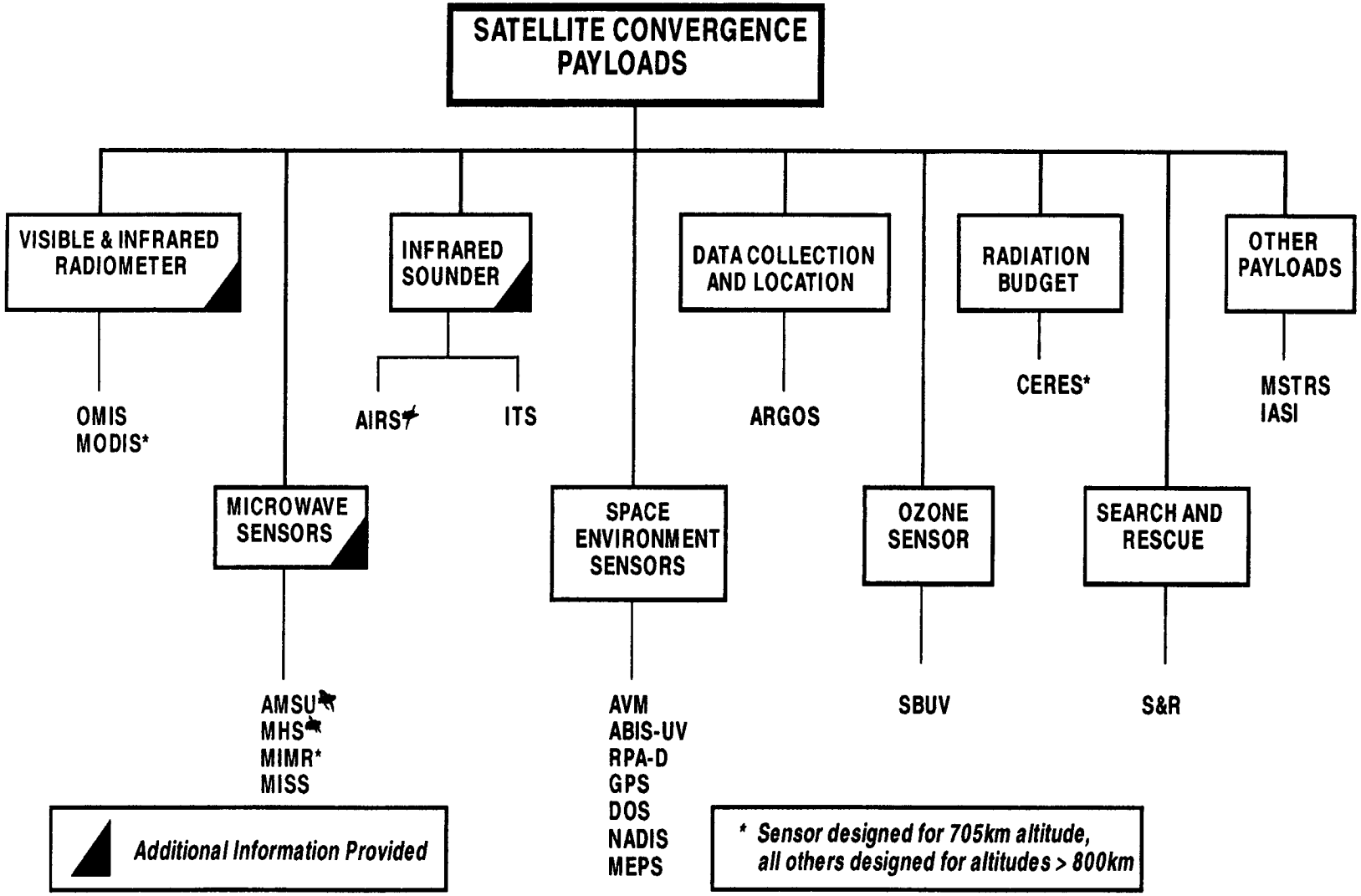
# SENSORS

# 6 INTRODUCTION

***MAJOR TOPICS OF DISCUSSION***

- ***OVERVIEW OF CONVERGENCE PAYLOADS***
  - SENSOR CHARACTERISTICS
  - PAYLOAD CHARACTERISTICS COMPARISON
  - SENSOR VOLUME AND WEIGHT COMPARISON
  - SENSOR POINTING KNOWLEDGE AND STABILITY REQUIREMENTS
  - VISIBLE AND IR IMAGER SPECTRAL CHANNEL COMPARISON
- ***SENSOR DISCUSSIONS***
  - VISIBLE AND INFRARED RADIOMETERS
  - INFRARED SOUNDERS
  - MICROWAVE SENSORS
- ***SUMMARY***

# 6 CONVERGENCE PAYLOADS



DMSP BLOCK SIX

# 6 SENSOR CHARACTERISTICS (SH 1 OF 2)

| INSTRUMENT | V | S | N | Volume | Footprint | Wt | Power | Attitude | Data Rate | FOV | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SPECS | MM | MM | MM | Cubic m | Sq meters | Kg | Watts | Know(deg) | Kbps | deg | |
| | | | | | | * | | | | | * Wt incl conting |
| | | | | | | | | | | | & antennas |
| OMIS-Optics/7 | 1321 | 635 | 610 | 0.512 | 0.839 | 88 | 195 | 0.03 | 2800 | ±55.7 xtrk | w/o sunshade |
| OMIS-Optics/8 | 1321 | 635 | 610 | 0.512 | 0.839 | 89 | 230 | 0.03 | 4500 | ±55.7 xtrk | w/o sunshade |
| OMIS-Elect'r'x | 760 | 410 | 200 | 0.062 | 0.312 | 32 | | | | | |
| OMIS-Ps | 300 | 200 | 200 | 0.012 | 0.060 | 11 | | | | | |
| AVHRR/3 | 800 | 292 | 366 | 0.085 | 0.234 | 30 | 30 | 0.05 | 1200 | | |
| VIRSR | 850 | 600 | 400 | 0.204 | 0.510 | 50 | 55 | 0.25 | 1044 | (+57, -75) | |
| MODIS | 970 | 1590 | 990 | 1.527 | 1.542 | 238 | 225 | 0.03 | 6500 | ±58 xtrk | Data Rate 11M sun |
| | | | | | | | | | | | |
| MISS | 510 | 510 | 510 | 0.533 | 0.260 | 100 | 175 | 0.05 | 37.3 | ±70az,+56el | & 2 M Dish (.4 CM) |
| MIMR | 1022 | 1600 | 2151 | 3.517 | 1.635 | 273 | 200 | 0.05 | 100 | ±80az,+46el | Dim's Stowed |
| CERES | 590 | 570 | 700 | 0.235 | 0.336 | 45 | 50 | 0.03 | 10 | ±84 cone, +Z | |
| | | | | | | | | | | | |
| AMSU-A1 | 731 | 337 | 605 | 0.149 | 0.246 | 50 | 90 | 0.1 | 2.1 | (+50,-90) | |
| AMSU-A2 | 635 | 754 | 685 | 0.328 | 0.479 | 50 | 37 | 0.1 | 1.1 | (+50,-90) | |
| MHS-Sen & Electr | 774 | 990 | 560 | 0.429 | 0.766 | 65 | 90 | 0.1 | 4.2 | (+50,-90) | |
| ITS | 600 | 400 | 400 | 0.096 | 0.240 | 40 | 75 | tbd | 1200 | tbd | |
| AIRS | 1397 | 775 | 762 | 0.825 | 1.083 | 165 | 265 | 0.2 | 1330 | ±55 xtrk | |
| | | | | | | | | | | | |
| SBUV-Sensor | 370 | 325 | 610 | 0.073 | 0.120 | 50 | 25 | | 0.38 | ±6 nadir | |
| SBUV-Elect | 245 | 341 | 365 | 0.030 | 0.084 | 0 | 0 | | | | |
| TOMS | 500 | 500 | 610 | 0.153 | 0.250 | 30 | 25 | 0.05 | 0.54 | ±54 xTrk | |
| | | | | | | | | | | | |

# 6 SENSOR CHARACTERISTICS (SH 2 OF 2)

| INSTRUMENT | V | S | N | Volume | Footprint | Wt | Power | Attitude | Data Rate | FOV | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SPECS | MM | MM | MM | Cubic m | Sq meters | Kg | Watts | Know(deg) | Kbps | deg | |
| | | | | | | * | | | | | * Wt incl conting |
| | | | | | | | | | | | & antennas |
| SESS: | | | | | | | | | | | |
| AVM | 164 | 141 | 52 | 0.001 | 0.023 | 10 | 1 | N/A | 0.24 | in-situ | w/o Sensor Boom * |
| ABIS-UV | 250 | 560 | 330 | 0.046 | 0.140 | 8 | 7 | 0.1 | 3 | ±50 xtrk | |
| RPA | 230 | 250 | 250 | 0.014 | 0.058 | 11 | 11 | 0.1 | 2 | ±60,vel vect | w/o grd plane * |
| GPS-Rcvr | 250 | 225 | 120 | 0.007 | 0.056 | 4 | 6 | 0.3 | 2 | omni | w/o antennas * |
| GPS-Process | 170 | 100 | 70 | 0.001 | 0.017 | 3 | 6 | 0 | 0 | | |
| DOS | 203 | 140 | 312 | 0.009 | 0.028 | 6 | 6 | N/A | 0.27 | omni | |
| NADIS | 467 | 300 | 330 | 0.046 | 0.140 | 8 | 7 | 0.1 | 1 | earth limb | |
| MEPS | 222 | 146 | 152 | 0.005 | 0.032 | 4 | 5 | 0.1 | 1.2 | 8x128,zenith | |
| | | | | | | | | | | | |
| SEM | | | | | | | | | | | |
| TED | 207 | 340 | 205 | 0.014 | 0.070 | 6.7 | 0 | | 0.16 | ~ 4-15's | Pwr incl in DPU |
| MEPED | 305 | 140 | 275 | 0.012 | 0.043 | 10.8 | 0 | | 0 | ±60-Z,4-30's | Pwr incl in DPU |
| LEFI | 317 | 348 | 492 | 0.054 | 0.110 | 8.4 | 10.8 | | 0.38 | unob hemis -X,+Y | |
| DPU | 315 | 300 | 90 | 0.009 | 0.095 | 5.3 | 23 | | 0.16 | | |
| | | | | | | | | | | | |
| S&R-RPU(2) | 195 | 365 | 280 | 0.020 | 0.071 | 31.2 | 22.8 | | | | |
| S&R-SPU | 195 | 310 | 280 | 0.017 | 0.060 | 14.4 | 6 | | | | |
| S&R-Rcvr | 458 | 458 | 152 | 0.032 | 0.210 | 15.2 | 21 | | | omni | w/o antennas * |
| S&R-Xmit | 350 | 370 | 115 | 0.015 | 0.130 | 15.2 | 39 | | | omni | w/o antennas * |
| ARGOS-RPU | 195 | 365 | 280 | 0.020 | 0.071 | 16.8 | 25.2 | | 2.56 | omni | w/o antennas * |
| ARGOS-SPU(2) | 195 | 310 | 280 | 0.034 | 0.121 | 31.2 | 7.2 | | | | |
| ARGOS-DCSR | 195 | 310 | 280 | 0.017 | 0.060 | 18 | 30 | | | | |
| | | | | | | | | | | | |
| MSTRS-RCVR | 76 | 127 | 102 | 0.001 | 0.010 | | | | | | |
| MSTRS-XMT/PROC | 127 | 178 | 127 | 0.003 | 0.023 | 5 | 20 | N/A | 0 | | |
| MSTRS-SENSOR | 152 | 152 | 152 | 0.004 | 0.023 | | | | | | |
| | | | | | | | | | | | |

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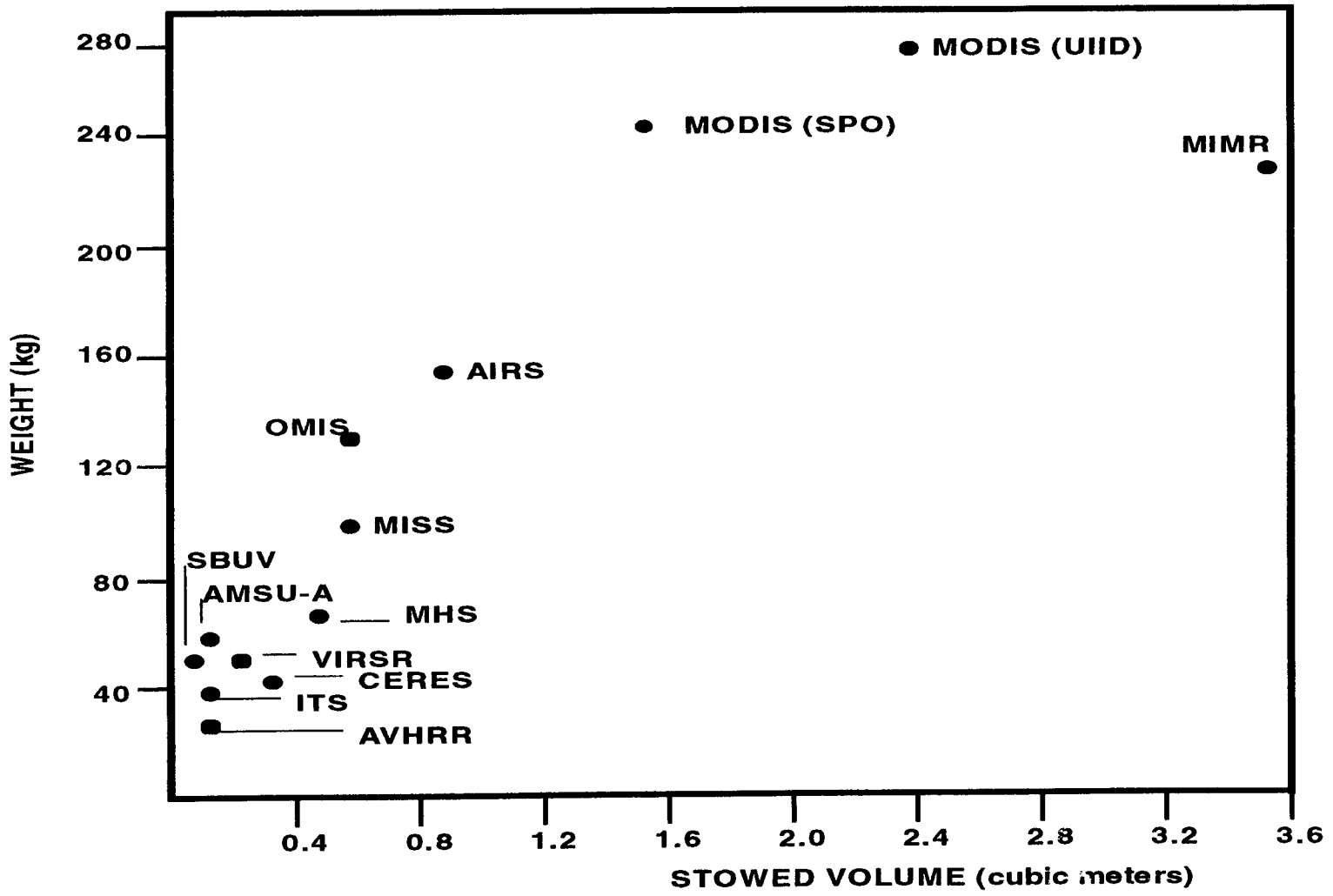
# 6 PAYLOAD CHARACTERISTICS COMPARISON

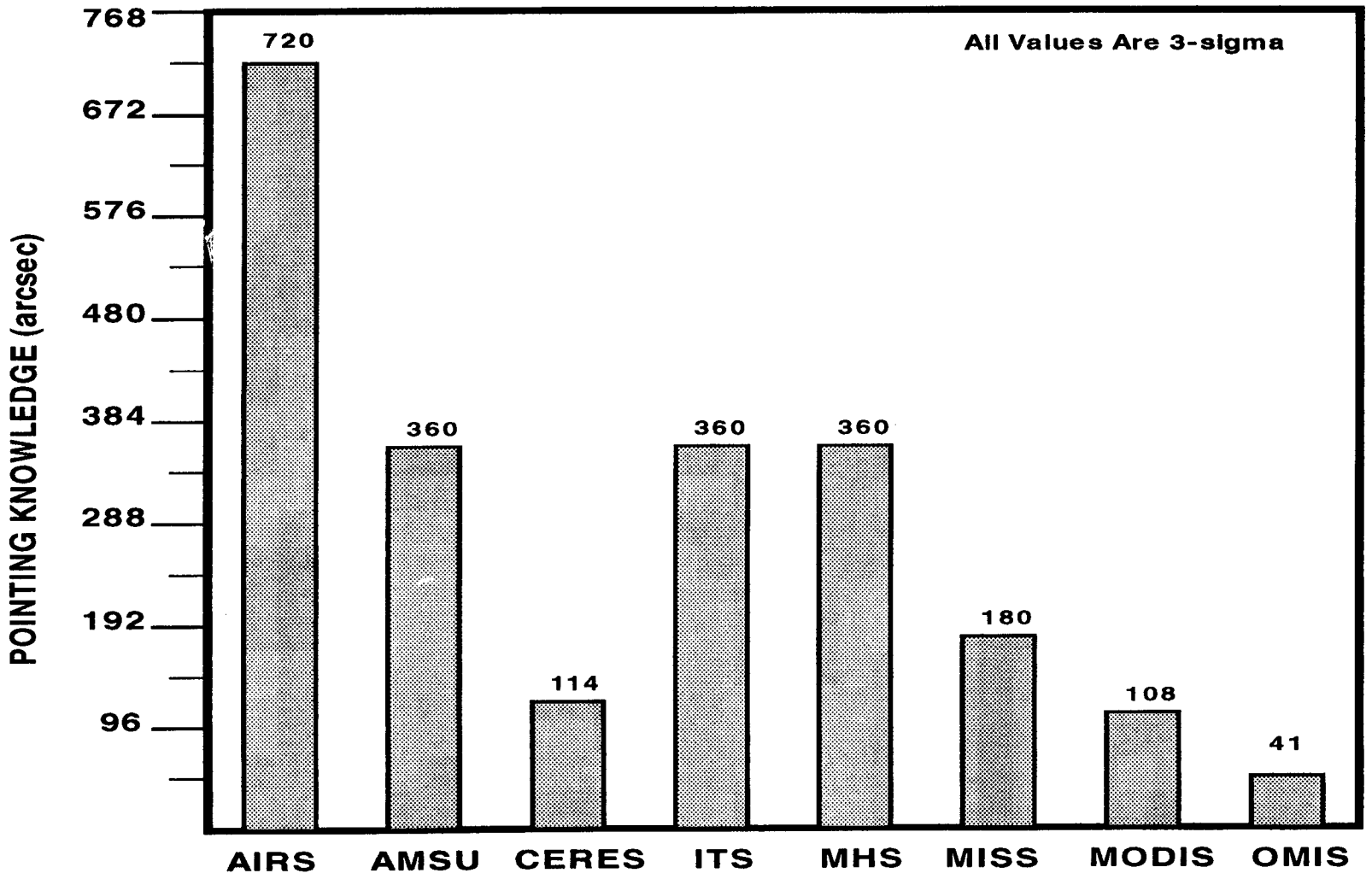
| SENSOR | MASS (kg) | POWER (w) | DATA (kbps) | DIMENSIONS (mm) Vel | A-sun | Earth | COMMENTS | SOURCE |
|---|---|---|---|---|---|---|---|---|
| AIRS | 165 | 265 | 1330 | 1397<br>1397<br>984 | 1512<br>775<br>737 | 762<br>762<br>762 | Total<br>Scan/Elec<br>Earth Shield | SPO |
| AIRS | 153 | 256 | 1440 | 1397<br>1397 | 775<br>1512 | 762<br>762 | Stowed<br>Deployed | AIRS UIID<br>GSFC 422-12-11-02<br>June 1993 |
| AMSU-A1 | 50 | 90 | n/a | n/a | n/a | n/a | None | SPO |
| AMSU-A1 | 60 | 88 | 2.1 | 731 | 337 | 605 | None | AMSU UIID<br>GSFC 422-12-12-02<br>June 1993 |
| MHS | 65 | 90 | n/a | n/a | n/a | n/a | None | SPO |
| MHS | 66 | 90 | 4.2 | 774 | 990 | 560 | None | MHS UIID<br>GSFC 422-12-14-02<br>June 1993 |
| SBUV | 50 | 25 | 0.38 | Dimensions OK | | | None | SPO |
| SBUV | 48 | 24 | 0.38 | | | | None | NOAA Phase A |
| CERES | 45 | 42 | 10 | 590 | 570 | 700 | None | SPO |
| CERES | 45 | 42 | 10 | 600 | 600 | 567 | None | CERES UIID<br>GSFC 422-12-13-02<br>June 1993 |
| MODIS | 238 | 225 | 10.1m day<br>2.7m nite | 970 | 1590 | 990 | None | SPO |
| MODIS | 278 | 240 | 10.8m day<br>6.2m avg<br>2.7m nite | 1121 | 1740 | 1213 | Stowed | MODIS UIID<br>GSFC 422-12-04-01<br>June 1993 |

DMSP BLOCK SIX

# 6 SENSOR VOLUME AND WEIGHT COMPARISON

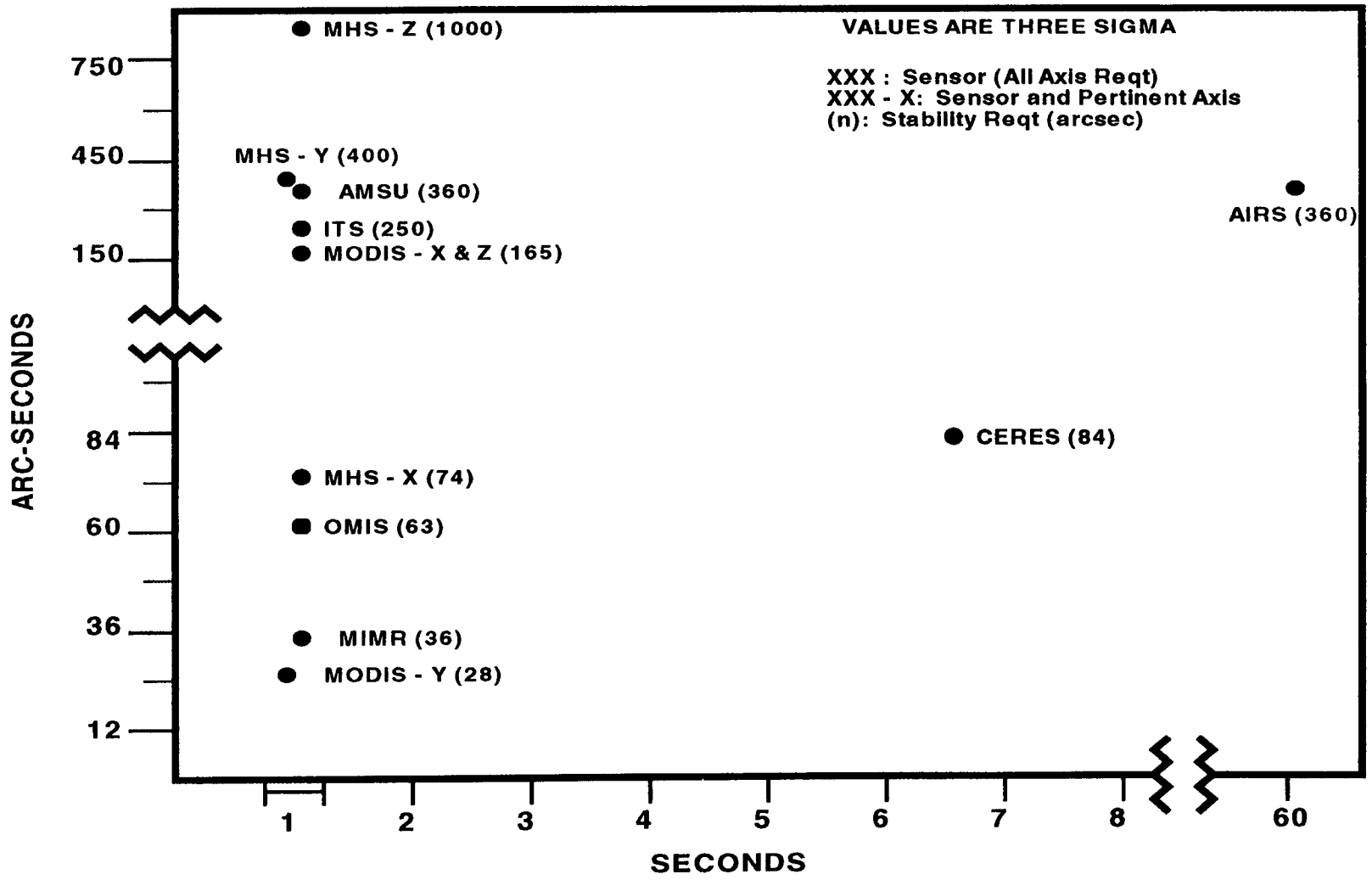


# 6 SENSOR POINTING KNOWLEDGE REQUIREMENTS



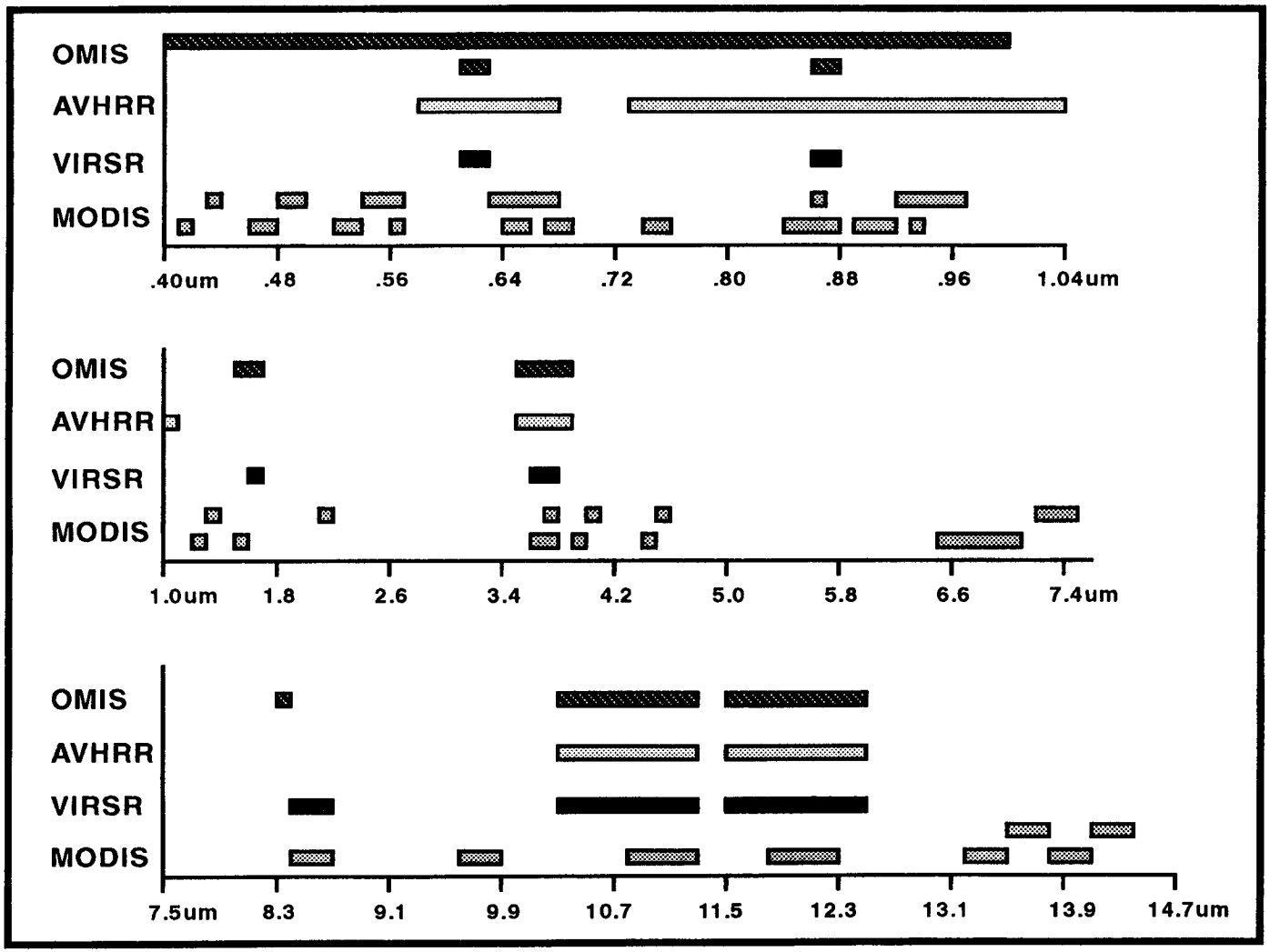
DMSP BLOCK SIX

# 6 SENSOR POINTING STABILITY REQUIREMENTS



DMSP BLOCK SIX

# 6 VISIBLE AND INFRARED IMAGER SPECTRAL CHANNEL COMPARISON

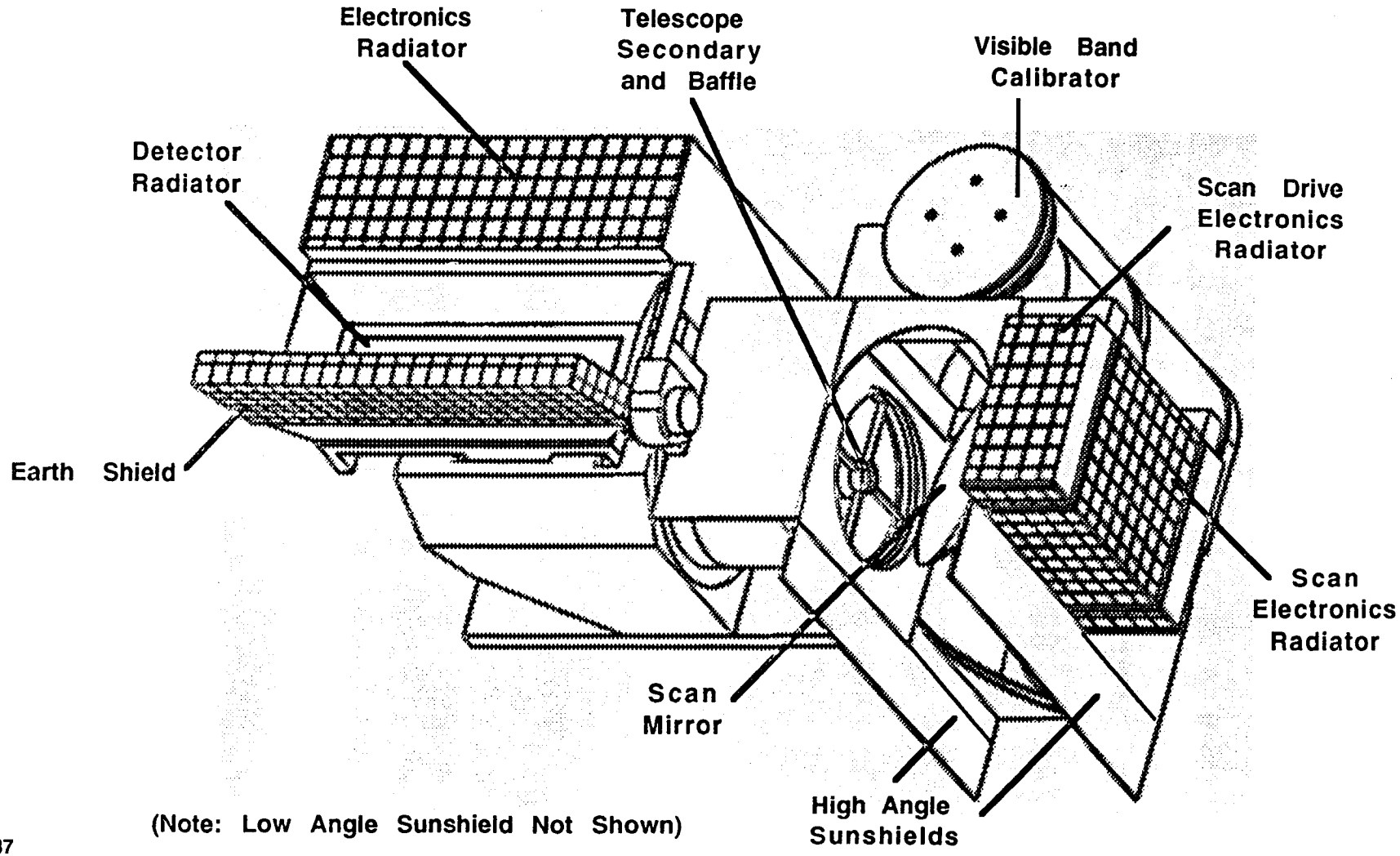



**MODIS lacks Required NOAA Channel at 0.615 um**

**NOTE**

**FWHM RESPONSE PLOTTED**

# 6 OMIS SENSOR MODULE




(Note: Low Angle Sunshield Not Shown)

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# 6 OMIS CHANGES CONSIDERED FOR STUDY PURPOSES

- BAND 8 ADDITION TO OMIS BASELINE (8.4 - 8.7 μm)
  - BASELINE ALWAYS HAD EXPANSION CAPABILITY
- ALTERNATE SPECTRAL BANDPASS FOR BANDS 1 AND 2 (FROM NOAA VIRSR)
  - BAND 1 CHANGED FROM 0.5 - 0.7 To 0.605 - 0.625 μm
  - BAND 2 CHANGED FROM 0.7 - 1.0 To 0.86 - 0.88 μm
  - SNR INCREASED FROM 15:1 TO 20:1
  - CALIBRATION ERROR CURRENTLY UNSPECIFIED
    - (BASELINE ACCURACY INCLUDES SNR/NE$\Delta$T AND CAL ERROR)
- LOW LIGHT LEVEL (LLL) SENSITIVITY RELAXED BY 4 TIMES
  - FROM 1.0E-09 W/CM2/SR TO 4.0E-09 W/CM2/SR
- DATA RATE CHANGED TO 12-BIT IN ALL BANDS
  - BASELINE USES 8-BIT FOR VISIBLE, 10-BIT FOR IR

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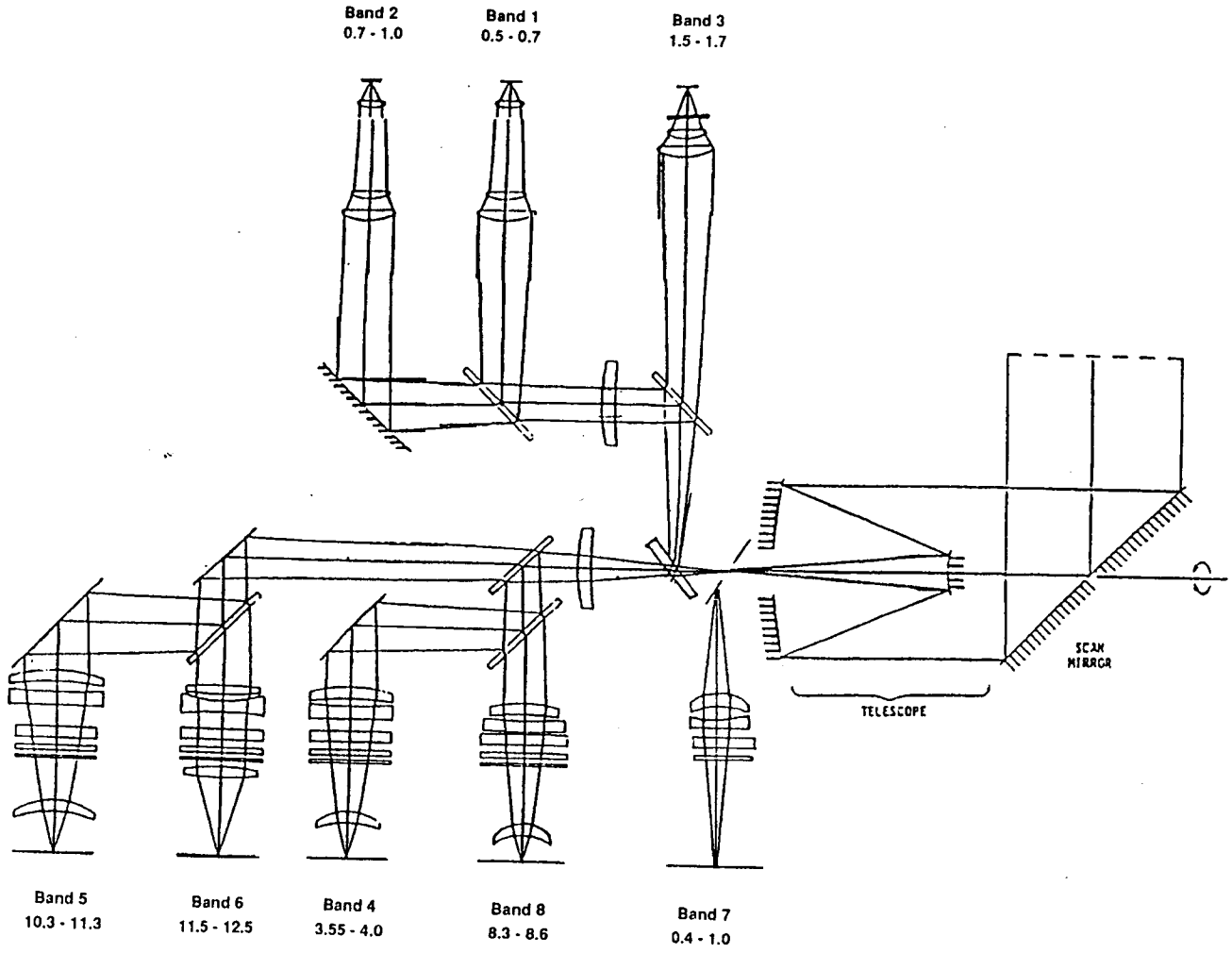
# 6 8 BAND OMIS LAYOUT IS CONSISTENT WITH OMIS BASELINE



DMSP BLOCK SIX

# 6 OMIS WEIGHT/POWER IMPACT FOR ADDING 8 uM BAND

| BANDS (NO.) | WEIGHT (KG) | | POWER (W) | |
|---|---|---|---|---|
| | W/MARGIN | MARGIN | W/MARGIN | MARGIN |
| 7 | 131.0 | 40.7 | 216.9 | 22.2 |
| 8 | 132.2 | 40.2 | 230.3 | 23.6 |

NOTE: WEIGHT IS FOR 450 NM AND INCLUDES THE 'CAL' UNIT

SIZE IS NOT IMPACTED; 52 x 25 x 24

# 6 OMIS PERFORMANCE

- SIGNIFICANT REDUCTION IN SIGNAL DUE TO NARROWER VISIBLE SPECTRAL BANDPASSES FOR CONVERGED SENSOR
  - OMIS BAND 1 SIGNAL REDUCED BY A FACTOR OF 10X
    - BANDPASS CHANGED FROM 0.5 - 0.7 To 0.605 - 0.625 μm
  - OMIS BAND 2 SIGNAL REDUCED BY A FACTOR OF 15.9X
    - BANDPASS CHANGED FROM 0.7 - 1.0 To 0.86 - 0.88 μm
- BY ITSELF, THE SNR OF 20:1 IS NOT THE ISSUE
  - CURRENTLY REQUIRE SNR OF 18:1 AT 0.25% ALBEDO
  - BASELINE OMIS SPECTRAL BANDPASSES ARE SIGNIFICANTLY WIDER THAN THE PROPOSED BANDS
- COMBINATION OF APERTURE SIZE INCREASE AND FPA COMPLEXITY INCREASE IS REQURIED WITH NARROW SPECTRAL BANDS
  - INCREASE APERTURE TO IMPROVE SIGNAL
  - MORE COMPLEX FPA TO REDUCE NOISE

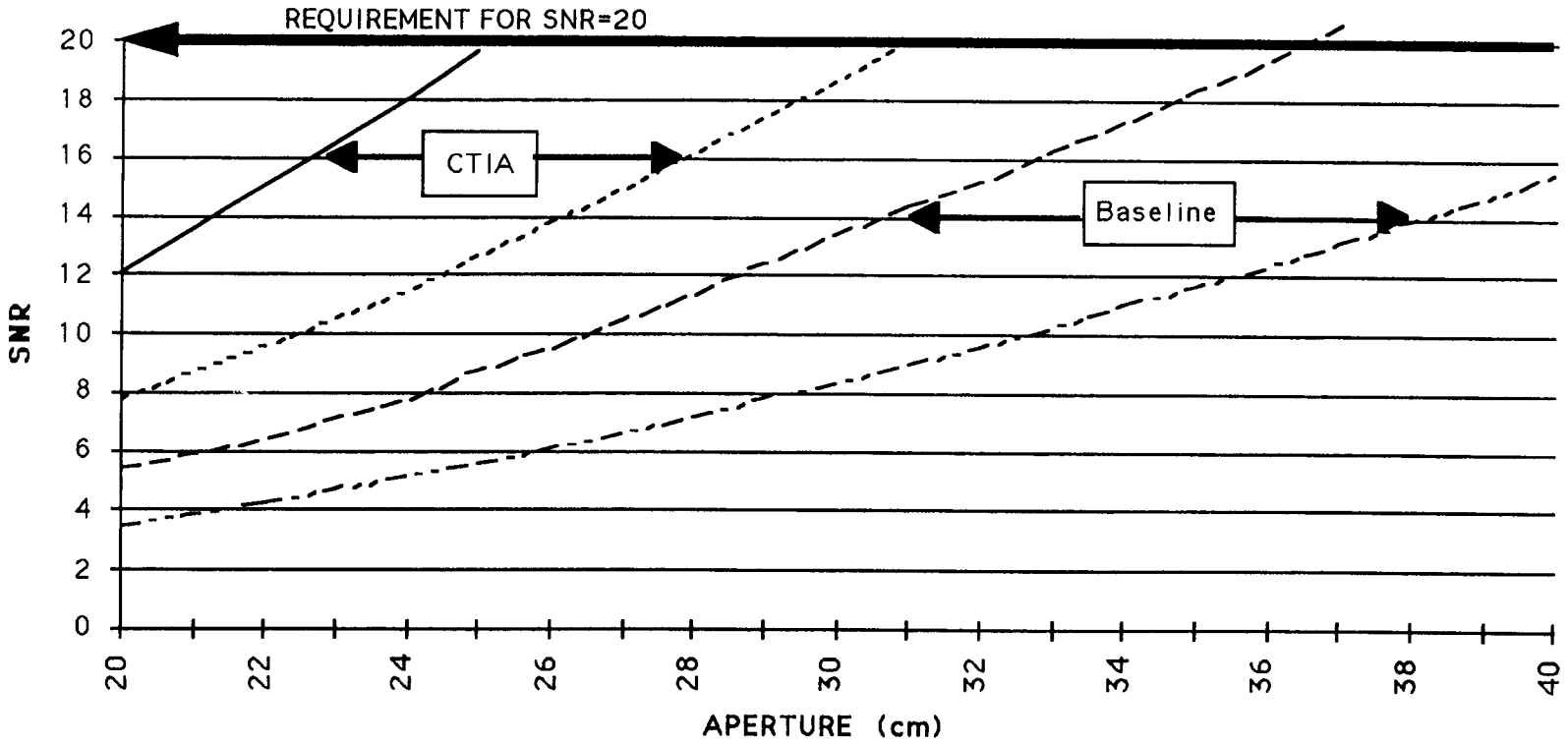
**OMIS SENSOR DESIGN IMPACT OF NARROW SPECTRAL BANDS**
- SNR OF 10:1 VIEWED AS REQUIRING A DESIGN MODIFICATION
- SNR OF 20:1 VIEWED AS A NEW SENSOR REQUIREMENT

DMSP BLOCK SIX

# 6 SNR VS APERTURE FOR BASELINE AND CHARGE INTEGRATOR READOUT

| CTIA | Baseline |
|---|---|
| ——— .605-.625μm - - - - - - - 0.86-0.88μm | — — — — .605-.625μm — · — · — 0.86-0.88μm |

Assumes CTIA Readout @ 200 rms Noise Electrons (Conservative)



DMSP BLOCK SIX

# 6 MODIS KEY DRIVERS AND ISSUES

- MODIS LACKS REQUIRED NOAA CHANNEL AT 0.615 um
- PHYSICAL CHARACTERISTICS DISCREPANCY BETWEEN MODIS UNIQUE INSTRUMENT INTERFACE DOCUMENT AND SPO-PROVIDED ATTACHMENT 2. SMALLER SPO DIMENSIONS USED.
- MODIS SIZE AND WEIGHT
- POINTING STABILITY REQUIREMENT OF 28 arcsec / sec
- 6.2 mbps AVERAGE DATA RATE AFFECTS DOWNLINK AND DATA STORAGE REQUIREMENTS
- MODIS DESIGN LIFE (5 vs 7 YEARS)

DMSP BLOCK SIX

# 6 MODERATE-RESOLUTION IMAGING SPECTRORADIOMETER (MODIS)

***MODIS IS A CROSS-TRACK SCANNING RADIOMETER WITH SPATIAL RESOLUTION OF 250 TO 1000m IN 36 BANDS BETWEEN 0.4 AND 15um DESIGNED TO MEASURE BIOLOGICAL AND PHYSICAL PROCESSES ON A GLOBAL BASIS EVERY ONE TO TWO DAYS***

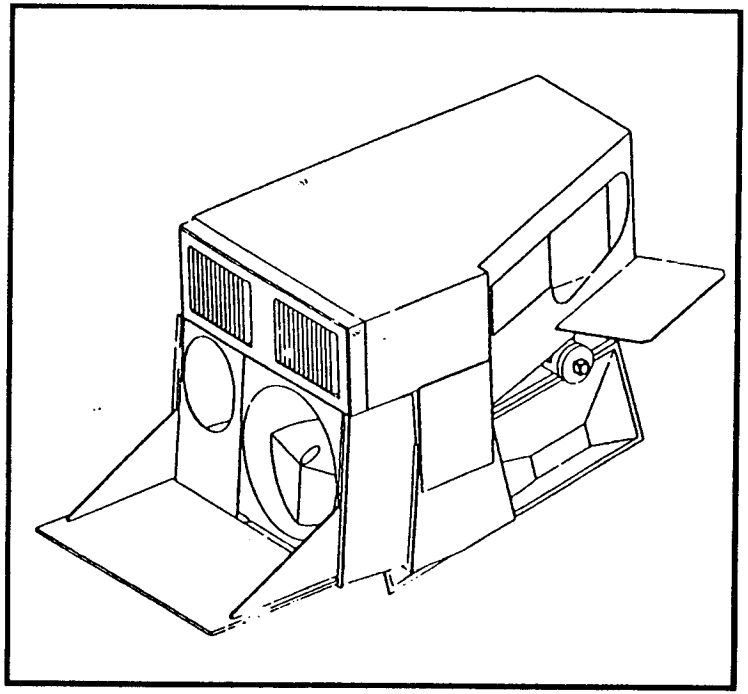
SCIENCE OBJECTIVES

- SURFACE TEMPERATURE WITH ACCURACY OF 0.2K (OCEAN) AND 1K (LAND)
- OCEAN COLOR WITHIN 5 PERCENT FROM 415 TO 653nm
- CHOLOROPHYLL FLUORESCENCE WITHIN 50 PERCENT
- VEGETATION / LAND SURFACE COVER, CONDITIONS AND PRODUCTIVITY
- CLOUD COVER WITH RESOLUTION OF 250m (DAY) AND 1000m (NIGHT)
- CLOUD AND AEROSOL PROPERTIES
- FIRE OCCURRENCE, SIZE AND TEMPERATURE
- GLOBAL DISTRIBUTION OF TOTAL PRECIPITABLE WATER

DMSP BLOCK SIX

# 6 MODIS - PHYSICAL CHARACTERISTICS -

- 36 SPECTRAL BANDS - 20 WITHIN 0.4 - 3.0um, 16 WITHIN 3 - 15um
- S/N RATIO: 830:1 (443nm), 745:1 (520nm), AND 503:1 (865nm)
- SWATH: 2300km WITH +/- 55deg SCAN ANGLE
- PHYSICAL SIZE: 112.1 x 174 x 121.3 cm (STOWED)
- MASS: 278kg
- DUTY CYCLE: 100%
- POWER: 240w (AVG), 275w (PEAK)
- DATA RATE: 6.2mbps (AVG), 11mbps (DAY)
  2.5mbps (NIGHT)
- THERMAL CONTROL: RADIATOR
- IFOV: 250m (2 BANDS), 500m (5 BANDS)
  1000m (29 BANDS)
- POINTING: CONTROL - 3600 arcsec, KNOWLEDGE - 108 arcsec,
  STABILITY - 28 arcsec/sec



= *Key Driver*

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# 6 MODIS SPECTRAL BANDS

| PURPOSE | BAND | CENTER* | IFOV (m) | WIDTH | UTILIZATION |
|---|---|---|---|---|---|
| Land and Cloud Boundaries Bands | 1 | 659 | 214 | 20 | veg chlorophyll abs, land cover trans. |
| | 2 | 865 | 214 | 50 | cloud and vegetation, land cover transf. |
| Land and Cloud Properties Bands | 3 | 470 | 428 | 20 | soil, vegetation differences |
| | 4 | 555 | 428 | 20 | green vegetation |
| | 5 | 1240 | 428 | 20 | leaf / canopy properties |
| | 6 | 1640 | 428 | 20 | snow / cloud differences |
| | 7 | 2130 | 428 | 50 | land and cloud properties |
| Ocean Color Bands | 8 | 415 | 856 | 15 | chlorophyll |
| | 9 | 443 | 856 | 10 | chlorophyll |
| | 10 | 490 | 856 | 10 | chlorophyll |
| | 11 | 531 | 856 | 10 | chlorophyll |
| | 12 | 565 | 856 | 10 | sediments |
| | 13 | 653 | 856 | 15 | sediments, atmosphere |
| | 14 | 681 | 856 | 10 | chlorophyll fluorescence |
| | 15 | 750 | 856 | 10 | aerosol properties |
| | 16 | 865 | 856 | 15 | aerosol / atmospheric properties |
| Atmosphere and Cloud Bands | 17 | 905 | 856 | 30 | cloud / atmospheric properties |
| | 18 | 936 | 856 | 10 | cloud / atmospheric properties |
| | 19 | 940 | 856 | 50 | cloud / atmospheric properties |
| Thermal Bands | 20 | 3.75 | 856 | 0.18 | sea surface temperature |
| | 21 | 3.75 | 856 | 0.05 | forest fires / volcanoes |
| | 22 | 3.96 | 856 | 0.05 | cloud / surface temperature |
| | 23 | 4.05 | 856 | 0.05 | cloud / surface temperature |
| | 24 | 4.47 | 856 | 0.05 | tropospheric temperature / cloud fraction |
| | 25 | 4.52 | 856 | 0.05 | tropospheric temperature / cloud fraction |
| | 26 | 1.38 | 856 | 0.05 | cirrus cloud ident, land / ocean temperature |
| | 27 | 6.72 | 856 | 0.36 | mid-tropospheric humidity |
| | 28 | 7.33 | 856 | 0.30 | upper-tropospheric humidity |
| | 29 | 8.55 | 856 | 0.30 | surface temperature |
| | 30 | 9.73 | 856 | 0.30 | total ozone |
| | 31 | 11.03 | 856 | 0.50 | cloud / surface temperature |
| | 32 | 12.02 | 856 | 0.30 | cloud / surface temperature |
| | 33 | 13.34 | 856 | 0.30 | cloud height and fraction |
| | 34 | 13.64 | 856 | 0.30 | cloud height and fraction |
| | 35 | 13.94 | 856 | 0.30 | cloud height and fraction |
| | 36 | 14.24 | 856 | 0.30 | cloud height and fraction |

* Band center and bandwidth are in nanometers for bands 1-19 and micrometers for bands 20-36

# 6 INFRARED SOUNDERS KEY DRIVERS / ISSUES

## *AIRS KEY DRIVERS AND ISSUES*

- PHYSICAL CHARACTERISTICS DISCREPANCY BETWEEN AIRS UNIQUE INSTRUMENT INTERFACE DOCUMENT AND SPO-PROVIDED ATTACHMENT 2
- SIZE AND WEIGHT
- 1.42 mbps AVERAGE DATA RATE AFFECTS DOWNLINK AND DATA STORAGE REQUIREMENTS
- AIRS DESIGN LIFE (5 vs 7 YEARS)

## *ITS KEY DRIVERS AND ISSUES*

- DATA RATE AS COMPARED TO IR SOUNDERS OF SIMILAR SIZE, WEIGHT AND POWER (1.2 mbps vs 3 - 4 kbps)

# 6 AIRS CONSIDERATIONS

- **AIRS PHYSICAL CHARACTERISTICS UPDATE**

  In June 1993, NASA/GSFC released a revised AIRS Instrument Description Document.

  Major change from 1993 EOS Reference Handbook is deletion of electronics radiators and placement of responsibility for waste heat acquisition / rejection on the Spacecraft Contractor. Stowed dimensions also changed:

  PHYSICAL DIMENSIONS (stowed): was: 157.5 x 77.5 x 101.6cm
  now: 139.7 x 77.5 x 76.2cm (used for this study)

- **AIRS SIZE DRIVES SPACECRAFT PACKAGING**

- **FOV COREGISTRATION AND SCAN SYNCHRONIZATION WITH MICROWAVE SENSORS**

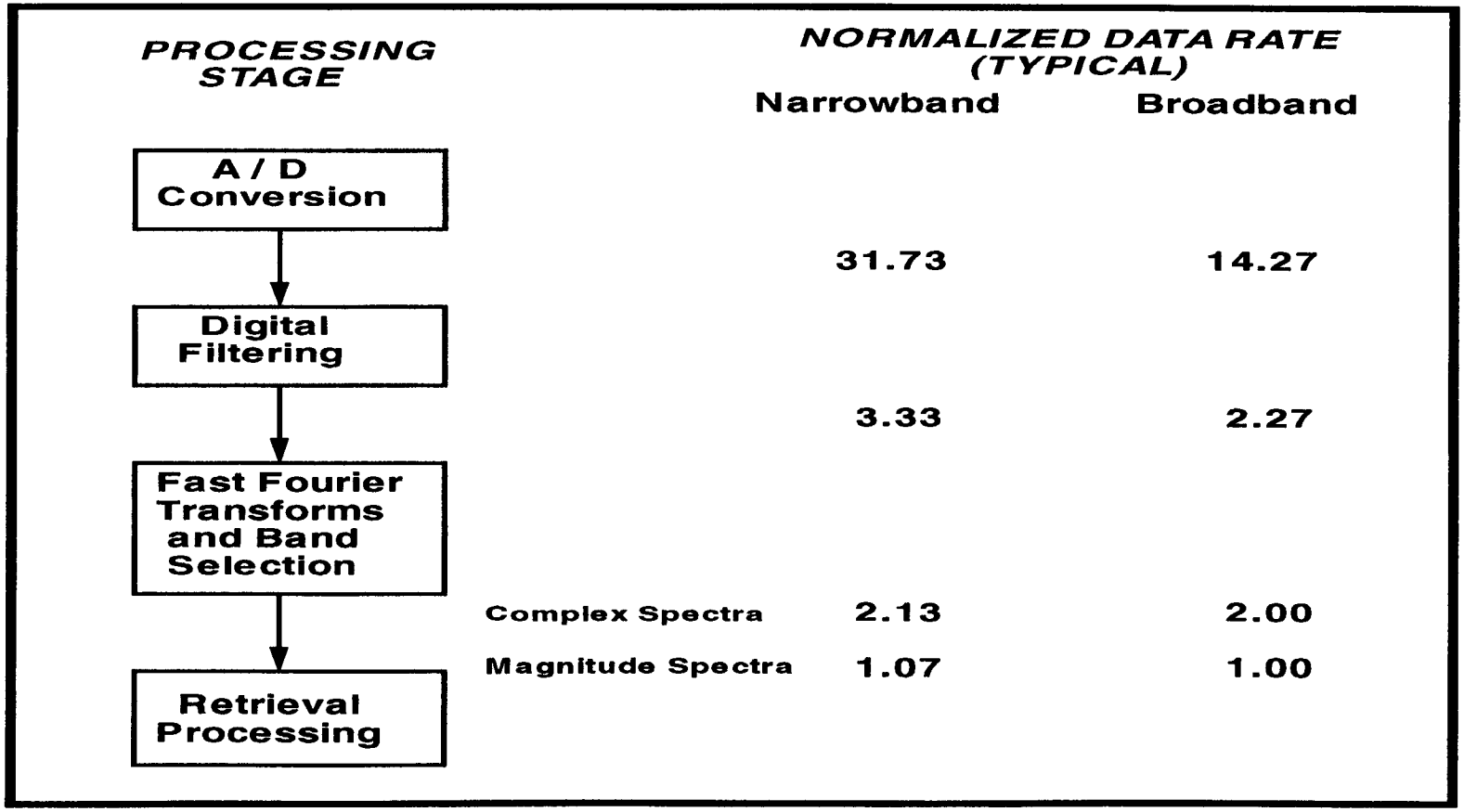
- **DATA RATE OF 1.42mbps IS A BIG DATA DOWNLINK DRIVER WITHOUT DATA COMPRESSION**

# 6 INTERFEROMETER THERMAL SOUNDER COMPARISONS

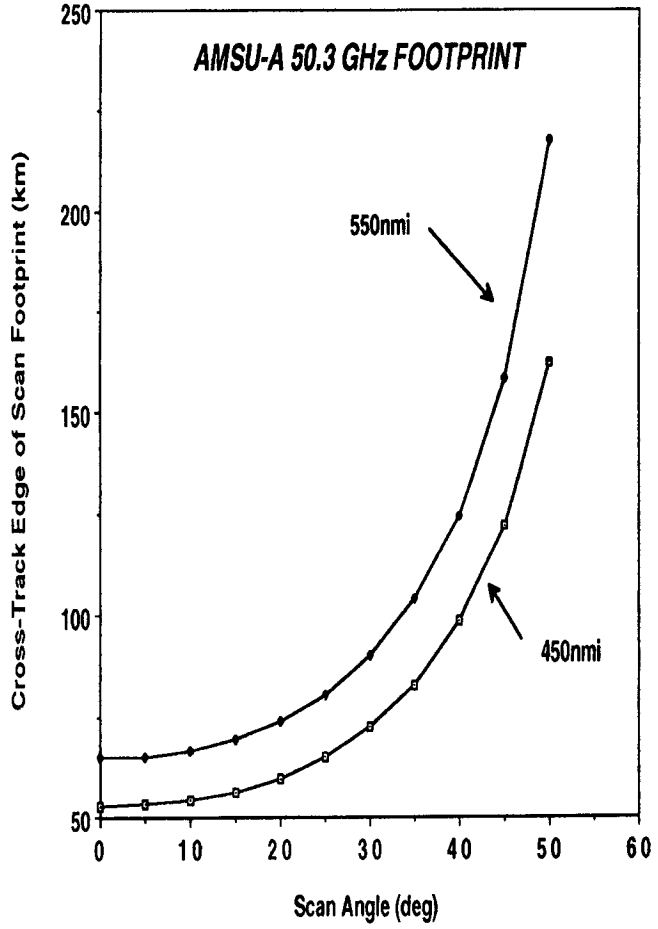
| | HIRS/3 | IRTS | ITS |
|---|---|---|---|
| SIZE (cm) V x S x N | 66.2 x 29.5 x 30.5 | 66.2 x 39.5 x 30.5 | 60 x 40 x 40 |
| WEIGHT (kg) | 40 | 55 | 40 |
| POWER (w) | 40 | 60 | 75 |
| ATTITUDE KNOWLEDGE (deg) | 0.1 | 0.1 | n/a |
| FOV (deg) | +50 to -72 | +50 to -72 | n/a |
| DATA RATE (kbps) | 2.9 | 3.5 | 1200 |

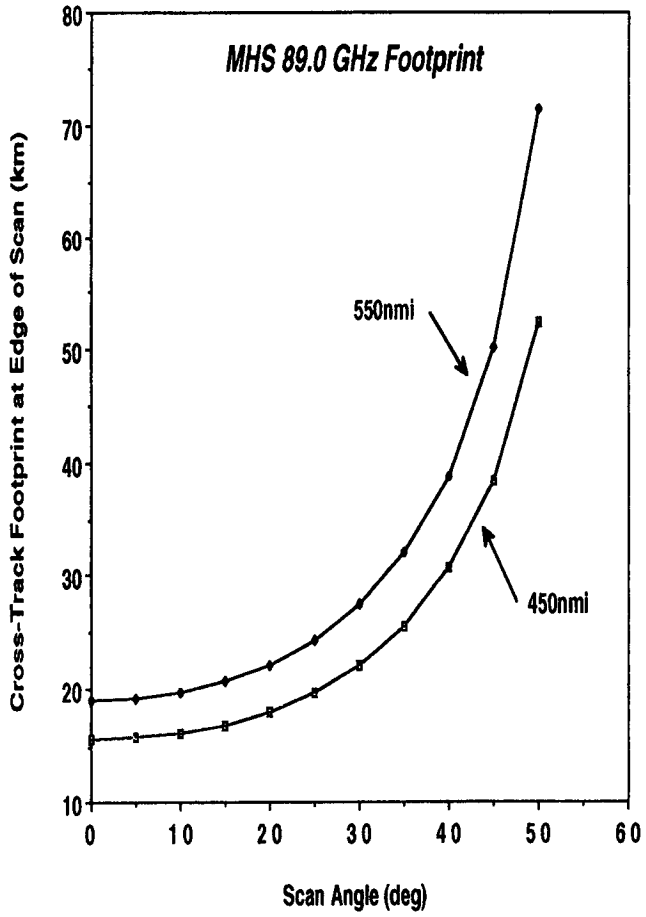
# 6 POTENTIAL DATA RATE REDUCTIONS FOR INTERFEROMETRIC SOUNDERS

***SIGNIFICANT DOWNLINKED DATA RATE REDUCTIONS CAN BE REALIZED BY DOING AS MUCH INTERFEROMETRIC SOUNDER DATA PROCESSING ONBOARD THE SPACECRAFT AS POSSIBLE***



# 6 AMSU-A AND MHS FOOTPRINTS AT 450 AND 550nmi ALTITUDE




**80% COVERAGE AT 450 nmi AND 93% COVERAGE AT 550 nmi FOR BASELINE 49.5 deg SCAN**

# 6 MICROWAVE SENSORS KEY DRIVERS / ISSUES

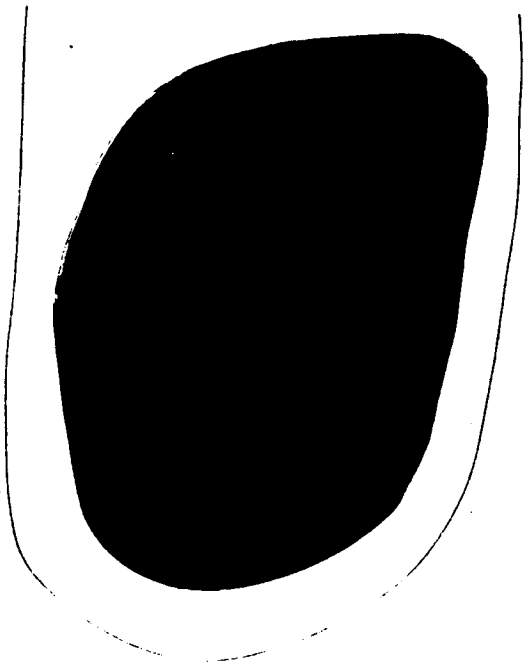
***AMSU and MHS***

- FOOTPRINT GROWTH AS A FUNCTION OF ALTITUDE
- AMSU & MHS DESIGN LIFE (5 vs 7 YEARS)

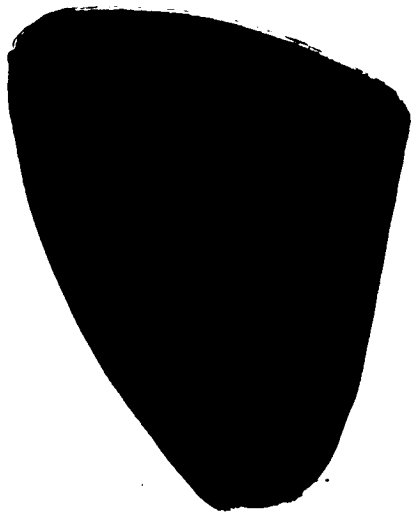
***MISS***

- CAN PERFORM MIMR FUNCTIONS ALONG WITH ADDED CAPABILITY (TEMPERATURE AND MOISTURE SOUNDING)
- MISS ADVANTAGES IN STOWED SIZE AND WEIGHT OVER MIMR
- MIMR TORQUE DISTURBANCE OF CONCERN
- MISS PROVIDES 100% CONTIGUOUS COVERAGE WITH 50km RESOLUTION AT 19.35 GHz
- DESIGN LIFE (MISS DESIGNED FOR 7 YEARS, MIMR FOR 5)

# 6 MIMR / MISS PHYSICAL CHARACTERISTICS COMPARISON



| MIMR ← | CHARACTERISTIC |
|---|---|
| 9 | NUMBER OF FEEDHORNS |
| 63 | REFLECTOR DIAMETER (in) |
| 43.6 | NADIR ANGLE (deg) |
| 50 | INCIDENCE ANGLE (deg) |
| 120 | SCAN ANGLE (deg) |
| 1400 | SWATH WIDTH (km) |
| **602** | WEIGHT (lbs) |
| 200 | POWER (w) |
| 100 | DATA RATE (kbps) |
| **3.517** | STOWED VOLUME (cu m) |



**Bold** = *Key Driver*

# 6 MIMR / MISS FREQUENCY COMPARISON

| PHYSICAL OBSERVABLE ↓ / SENSOR → | NOMINAL FREQUENCY OF OBSERVATION (GHz) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 6 | 10 | 19 | 22 | 37 | 50-60 | 90 | 150 | 183 |
| | MIMR | Both | Both | Both | Both | MISS | Both | MISS | MISS |
| Soil Moisture | ▭ | ▭ | ▭ | | | | ▭ | | |
| Snow | ▭ | ▭ | ■ | | ■ | | ▒ | | |
| Ocean Precipitation | | ▒ | ■ | ▭ | ▒ | | | | |
| Land Precipitation | | | ▒ | | ■ | | ■ | | ▒ |
| Sea Surface Temp. | ■ | ▒ | ▒ | ▒ | ▭ | | | | |
| Sea Ice Extent | | | ■ | | ■ | | ▭ | | |
| Sea Ice Type | ▭ | ▒ | ■ | | ■ | | ▒ | | |
| Ocean Wind Speed | | ■ | ▒ | ▭ | ▭ | | | | |
| Total Water Vapor (ocean) | | | ■ | ■ | ▒ | | | | |
| Water Vapor Profile | | | | ▒ | ▭ | ▒ | ▭ | ▒ | ■ |
| Cloud Water (ocean) | | | | ▒ | ■ | | ▒ | | |
| Temperature Profile | | | | ▭ | ▭ | ■ | ▭ | | |

Key: ▭ Helpful ▒ Important ■ Critical

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# 6 MIMR / MISS PERFORMANCE COMPARISON

| | MIMR | MISS |
|---|---|---|
| Frequency (GHz) | 6.63 | n/a |
| Resolution (km) | 60.3 | n/a |
| NEdT (K) | 0.4 | n/a |
| Frequency (GHz) | 10.65 | 10.65 |
| Resolution (km) | 38.6 | 90.0 |
| NEdT (K) | 0.3 | 0.24 |
| Frequency (GHz) | 18.0 | 19.35 |
| Resolution (km) | 22.3 | 50.0 |
| NEdT (K) | 0.4 | .17 - .31* |
| Frequency (GHz) | 21.0 | 23.8 |
| Resolution (km) | 22.3 | 50.0 |
| NEdT (K) | 0.4 | .17 - .31 |
| Frequency (GHz) | 37.0 | 37.0 |
| Resolution (km) | 11.6 | 25.0 |
| NEdT (K) | 0.4 | .43 - .95 |

| | MIMR | MISS |
|---|---|---|
| Frequency (GHz) | n/a | 50 - 63 |
| Resolution (km) | n/a | 50 |
| NEdT (K) | n/a | .27 - .50 |
| Frequency (GHz) | 90.0 | 91.65 |
| Resolution (km) | 4.9 | 12.5 |
| NEdT (K) | 0.7 | .52 - .87 |
| Frequency (GHz) | n/a | 150 |
| Resolution (km) | n/a | 12.5 |
| NEdT (K) | n/a | .7 - 2.57 |
| Frequency (GHz) | n/a | 170 - 183 |
| Resolution (km) | n/a | 12.5 |
| NEdT (K) | n/a | 1.19 - 2.18 |

* MISS NEdT values represent a performance range depending on receiver design

# 6 PAYLOAD SUMMARY

- EOS SENSORS (AIRS, MODIS, MIMR etc) ARE DRIVERS IN AREAS OF SIZE, WEIGHT, POWER, DATA RATE, POINTING AND DESIGN LIFE
- EOS SENSORS ARE DESIGNED TO FLY AT 705 km ALTITUDE
- NARROW SPECTRAL BANDS COUPLED WITH SNR REQUIREMENTS CAN RESULT IN SIGNIFICANT OMIS IMPACT
- INTERFEROMETER THERMAL SOUNDER DATA RATE CAN BE A DRIVER DEPENDING ON EXTENT OF DATA CONDITIONING DONE WITHIN THE SENSOR
- MISS CAN PERFORM SIMILAR FUNCTIONS AS MIMR PLUS ADDITIONAL FUNCTIONS WITH SIGNIFICANT SAVINGS IN SIZE AND WEIGHT

# 6

# SATELLITE PAYLOAD CONFIGURATION LAYOUTS

# 6 PAYLOAD CONFIGURATION ANALYSIS

| CONFIGURATION | A 1 | A 2 | A 3 | B 1 | B 2 | B 3 | C 1 | C 2 | C 3 | D 1 | D 2 | D 3 | E 1 | E 2 | E 3 | F 1 | F 2 | F 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SENSOR | | | | | | | | | | | E | | | | E | | E | |
| OMIS/8 | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| MISS | X | X | X | X | X | X | X | X | X | X | | X | X | X | | X | | X |
| MIMR | | | | | | | | | | | | | | | | | | |
| AMSU-A1 | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| AMSU-A2 | | | | | | | | | | | X | | | | X | | X | |
| MHS (S&E) | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| ITS | X | | X | | | | | | | | | | X | | | | | |
| AIRS | | | | X | | X | X | | X | | | X | | | | X | | X |
| SBUV(S&E) | | | X | | | X | | | X | | | X | | | X | | | X |
| TOMS | | | | | | | | | | | | | | | | | | |
| CERES | | | | | | X | | | | | | | | | | | | X |
| MODIS | | | | | | X | | | | | | | | | | | | X |
| AVM | X | X | X | X | X | X | X | X | X | X | | X | X | X | | X | | X |
| ABIS-UV | X | X | X | X | X | X | X | X | X | X | | X | X | X | | X | | X |
| RPA | X | X | X | X | X | X | X | X | X | X | | X | X | X | | X | | X |
| GPS | X | X | X | X | X | X | X | X | X | X | | X | X | X | | X | | X |
| DOS | X | X | X | X | X | X | X | X | X | X | | X | X | X | | X | | X |
| NADIS | X | X | X | X | X | X | X | X | X | X | | X | X | X | | X | | X |
| MEPS | X | X | X | X | X | X | X | X | X | X | | X | X | X | | X | | X |
| SEM | | | | | | | | | | | X | | | | X | | X | |
| S & R | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| ARGOS | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| MSTRS | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| IASI | | | | | | | | | | | X | | | | X | | X | |
| | | | | | | | | | | | E = EUROPEAN | | | | | | | |
| WEIGHT (KG) | 588 | 548 | 638 | 713 | | 1046 | | | 763 | | | | | | | | | |
| VOLUME (CM) | 2.08 | 1.99 | 2.19 | 2.81 | | 4.68 | | | 2.92 | | | | | | | | | |
| POWER (W) | 880 | 805 | 905 | 1070 | | 1370 | | | 1095 | | | | | | | | | |
| DATA RATE (Mbps | 6.8 | 5.6 | 6.8 | 6.9 | | 13.4 | | | 6.9 | | | | | | | | | |

CONFIGURATION ANALYSIS

A1=E1

A2=B2=C2=D1=E2

B1=C1=F1

B3=F3

C3=D3

"E" = D2=E3=F2

TOTAL REDUNDANT OR "E" = 12

LEAVES 6 UNIQUE CONFIG'S

A3 ('ITS')
C3 ('AIRS')
B3 ('EOS')
A1 = A3 - SBUV
A2 = A1 - ITS
B1 = C3 - SBUV

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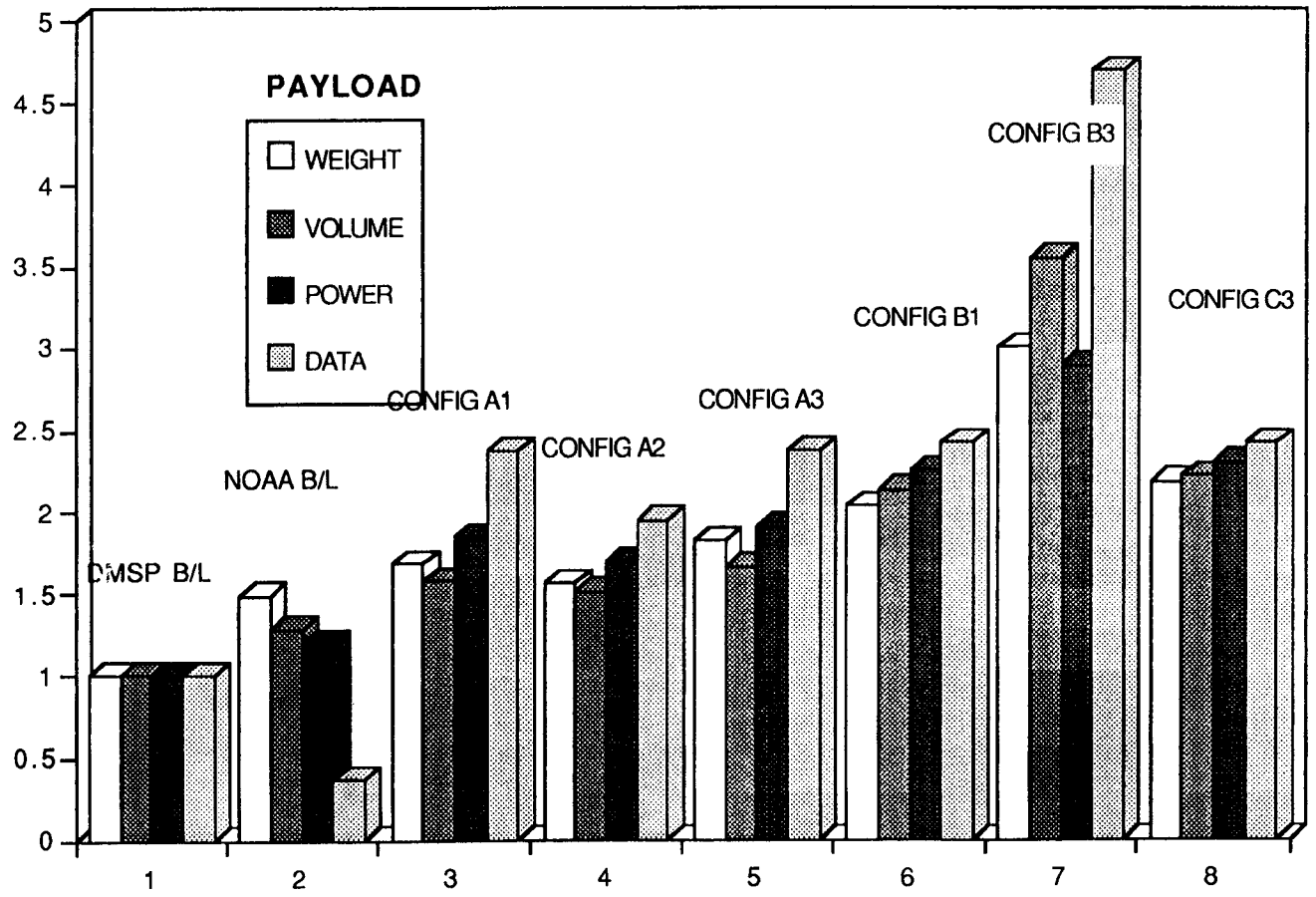
# 6 PAYLOAD PARAMETER SUMMARY

| CONFIGURATION | A | | | B | | | C | | | DMSP | NOAA |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 1 | 2 | 3 | 1 | 2 | 3 | BLK6 | OPQ' |
| SENSOR | | | | | | | | | | | |
| OMIS/8 | X | X | X | X | X | X | X | X | X | X | |
| VIRSR | | | | | | | | | | | X |
| MISS | X | X | X | X | X | X | X | X | X | X | |
| MIMR | | | | | | | | | | | |
| AMSU-A1 | X | X | X | X | X | X | X | X | X | | X |
| AMSU-A2 | | | | | | | | | | | X |
| MHS (S&E) | X | X | X | X | X | X | X | X | X | | X |
| ITS | X | | X | | | | | | | | |
| AIRS | | | | X | | X | X | | X | | |
| IRTS | | | | | | | | | | | X |
| SBUV(S&E) | | | X | | | X | | | X | | X |
| TOMS | | | | | | | | | | | X |
| CERES | | | | | | X | | | | | |
| MODIS | | | | | | X | | | | | |
| AVM | X | X | X | X | X | X | X | X | X | X | |
| ABIS-UV | X | X | X | X | X | X | X | X | X | X | |
| RPA | X | X | X | X | X | X | X | X | X | X | |
| GPS | X | X | X | X | X | X | X | X | X | X | |
| DOS | X | X | X | X | X | X | X | X | X | X | |
| NADIS | X | X | X | X | X | X | X | X | X | X | |
| MEPS | X | X | X | X | X | X | X | X | X | X | |
| SEM | | | | | | | | | | | X |
| S & R | X | X | X | X | X | X | X | X | X | | X |
| ARGOS | X | X | X | X | X | X | X | X | X | | X |
| MSTRS | X | X | X | X | X | X | X | X | X | X | |
| SDC | | | | | | | | | | X | |
| WEIGHT (KG) | 588 | 548 | 638 | 713 | | 1046 | | | 763 | 350 | 523 |
| VOLUME (CM) | 2.08 | 1.99 | 2.19 | 2.81 | | 4.68 | | | 2.92 | 1.32 | 1.69 |
| POWER (W) | 880 | 805 | 905 | 1070 | | 1370 | | | 1095 | 476 | 567 |
| DATA RATE (Mbps | 6.8 | 5.6 | 6.8 | 6.9 | | 13.4 | | | 6.9 | 2.85 | 1.06 |

DMSP BLOCK SIX

# 6 PAYLOAD COMPARISONS

## CONFIGURATIONS - RELATIVE PAYLOAD PARAMETER VALUES



# 6 SPACECRAFT LAYOUT SUMMARY

- [redacted] BUS SENSOR DESIGN
  - DMSP BASELINE GROWTH DESIGN ACCOMMODATES ALL VERSIONS ON DELTA II, (EXCEPT B3 EOS VERSION)

- B3 VERSION (EOS) -
  - FITS IN 14' SHROUD ON ATLAS IIAS
  - OTHER SOLUTIONS UNDER STUDY

# 6 PAYLOAD CONFIGURATION A1

| INSTRUMENT | V | S | N | Volume | Footprint | Wt | Power | Attitude | Data Rate | FOV | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SPECS | MM | MM | MM | Cubic m | Sq meters | Kg * | Watts | Know(deg) | Kbps | deg | * Wt incl conting & antennas |
| OMIS-Optics/8 | 1321 | 635 | 610 | 0.512 | 0.839 | 89 | 230 | 0.03 | 5500 | ±55.7 xtrk | w/o sunshade |
| OMIS-Elect'r'x | 760 | 410 | 200 | 0.062 | 0.312 | 32 | 0 | 0 | 0 | 0 | 0 |
| OMIS-Ps | 300 | 200 | 200 | 0.012 | 0.060 | 11 | 0 | 0 | 0 | 0 | |
| MISS | 510 | 510 | 510 | 0.533 | 0.260 | 100 | 175 | 0.05 | 37.3 | ±70az,+56el | & 2 M Dish (.4 CM) |
| AMSU-A1 | 731 | 337 | 605 | 0.149 | 0.246 | 50 | 90 | 0.1 | 2.1 | (+50,-90) | 0 |
| MHS-Sen & Electr | 774 | 990 | 560 | 0.429 | 0.766 | 65 | 90 | 0.1 | 4.2 | (+50,-90) | |
| ITS | 600 | 400 | 400 | 0.096 | 0.240 | 40 | 75 | tbd | 1200 | tbd | 0 |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| SESS: | | | | | | | | | | | |
| AVM | 164 | 141 | 52 | 0.001 | 0.023 | 10 | 1 | N/A | 0.24 | in-situ | w/o Sensor Boom * |
| ABIS-UV | 250 | 560 | 330 | 0.046 | 0.140 | 8 | 7 | 0.1 | 3 | ±50 xtrk | 0 |
| RPA | 230 | 250 | 250 | 0.014 | 0.058 | 11 | 11 | 0.1 | 2 | ±60,vel vect | w/o grd plane * |
| GPS-Rcvr | 250 | 225 | 120 | 0.007 | 0.056 | 4 | 6 | 0.3 | 2 | omni | w/o antennas * |
| GPS-Process | 170 | 100 | 70 | 0.001 | 0.017 | 3 | 6 | 0 | 0 | 0 | 0 |
| DOS | 203 | 140 | 312 | 0.009 | 0.028 | 6 | 6 | N/A | 0.27 | omni | |
| NADIS | 467 | 300 | 330 | 0.046 | 0.140 | 8 | 7 | 0.1 | 1 | earth limb | 0 |
| MEPS | 222 | 146 | 152 | 0.005 | 0.032 | 4 | 5 | 0.1 | 1.2 | 8x128,zenith | 0 |
| | | | | | | | | | | | |
| S&R-RPU(2) | 195 | 365 | 280 | 0.020 | 0.071 | 31.2 | 22.8 | 0 | 0 | 0 | 0 |
| S&R-SPU | 195 | 310 | 280 | 0.017 | 0.060 | 14.4 | 6 | 0 | 0 | 0 | 0 |
| S&R-Rcvr | 458 | 458 | 152 | 0.032 | 0.210 | 15.2 | 21 | 0 | 0 | omni | w/o antennas * |
| S&R-Xmit | 350 | 370 | 115 | 0.015 | 0.130 | 15.2 | 39 | 0 | 0 | omni | w/o antennas * |
| ARGOS-RPU | 195 | 365 | 280 | 0.020 | 0.071 | 16.8 | 25.2 | 0 | 2.56 | omni | w/o antennas * |
| ARGOS-SPU(2) | 195 | 310 | 280 | 0.034 | 0.121 | 31.2 | 7.2 | 0 | 0 | 0 | 0 |
| ARGOS-DCSR | 195 | 310 | 280 | 0.017 | 0.060 | 18 | 30 | 0 | 0 | 0 | 0 |
| MSTRS-RCVR | 76 | 127 | 102 | 0.001 | 0.010 | 0 | 0 | 0 | 0 | 0 | 0 |
| MSTRS-XMT/PROC | 127 | 178 | 127 | 0.003 | 0.023 | 5 | 20 | N/A | 0 | 0 | 0 |
| MSTRS-SENSOR | 152 | 152 | 152 | 0.004 | 0.023 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | | | | | | | |
| Totals | | | | 2.084 | 3.997 | 588 | 880 | | 6755.9 | | |

# 6 PAYLOAD CONFIGURATION A2, B2, C2

| INSTRUMENT | V | S | N | Volume | Footprint | Wt | Power | Attitude | Data Rate | FOV | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SPECS | MM | MM | MM | Cubic m | Sq meters | Kg * | Watts | Know(deg) | Kbps | deg | * Wt Incl conting & antennas |
| OMIS-Optics/8 | 1321 | 635 | 610 | 0.512 | 0.839 | 89 | 230 | 0.03 | 5500 | ±55.7 xtrk | w/o sunshade |
| OMIS-Elect'r'x | 760 | 410 | 200 | 0.062 | 0.312 | 32 | 0 | 0 | 0 | 0 | 0 |
| OMIS-Ps | 300 | 200 | 200 | 0.012 | 0.060 | 11 | 0 | 0 | 0 | 0 | |
| MISS | 510 | 510 | 510 | 0.533 | 0.260 | 100 | 175 | 0.05 | 37.3 | ±70az,+56el | & 2 M Dish (.4 CM) |
| AMSU-A1 | 731 | 337 | 605 | 0.149 | 0.246 | 50 | 90 | 0.1 | 2.1 | (+50,-90) | 0 |
| MHS-Sen & Electr | 774 | 990 | 560 | 0.429 | 0.766 | 65 | 90 | 0.1 | 4.2 | (+50,-90) | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| SESS: | | | | | | | | | | | |
| AVM | 164 | 141 | 52 | 0.001 | 0.023 | 10 | 1 | N/A | 0.24 | in-situ | w/o Sensor Boom * |
| ABIS-UV | 250 | 560 | 330 | 0.046 | 0.140 | 8 | 7 | 0.1 | 3 | ±50 xtrk | 0 |
| RPA | 230 | 250 | 250 | 0.014 | 0.058 | 11 | 11 | 0.1 | 2 | ±60,vel vect | w/o grd plane * |
| GPS-Rcvr | 250 | 225 | 120 | 0.007 | 0.056 | 4 | 6 | 0.3 | 2 | omni | w/o antennas * |
| GPS-Process | 170 | 100 | 70 | 0.001 | 0.017 | 3 | 6 | 0 | 0 | 0 | 0 |
| DOS | 203 | 140 | 312 | 0.009 | 0.028 | 6 | 6 | N/A | 0.27 | omni | |
| NADIS | 467 | 300 | 330 | 0.046 | 0.140 | 8 | 7 | 0.1 | 1 | earth limb | 0 |
| MEPS | 222 | 146 | 152 | 0.005 | 0.032 | 4 | 5 | 0.1 | 1.2 | 8x128,zenith | 0 |
| | | | | | | | | | | | |
| S&R-RPU(2) | 195 | 365 | 280 | 0.020 | 0.071 | 31.2 | 22.8 | 0 | 0 | 0 | 0 |
| S&R-SPU | 195 | 310 | 280 | 0.017 | 0.060 | 14.4 | 6 | 0 | 0 | 0 | 0 |
| S&R-Rcvr | 458 | 458 | 152 | 0.032 | 0.210 | 15.2 | 21 | 0 | 0 | omni | w/o antennas * |
| S&R-Xmit | 350 | 370 | 115 | 0.015 | 0.130 | 15.2 | 39 | 0 | 0 | omni | w/o antennas * |
| ARGOS-RPU | 195 | 365 | 280 | 0.020 | 0.071 | 16.8 | 25.2 | 0 | 2.56 | omni | w/o antennas * |
| ARGOS-SPU(2) | 195 | 310 | 280 | 0.034 | 0.121 | 31.2 | 7.2 | 0 | 0 | 0 | 0 |
| ARGOS-DCSR | 195 | 310 | 280 | 0.017 | 0.060 | 18 | 30 | 0 | 0 | 0 | 0 |
| MSTRS-RCVR | 76 | 127 | 102 | 0.001 | 0.010 | 0 | 0 | 0 | 0 | 0 | 0 |
| MSTRS-XMT/PROC | 127 | 178 | 127 | 0.003 | 0.023 | 5 | 20 | N/A | 0 | 0 | 0 |
| MSTRS-SENSOR | 152 | 152 | 152 | 0.004 | 0.023 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | | | | | | | |
| Totals | | | | 1.988 | 3.757 | 548 | 805 | | 5555.9 | | |

DMSP BLOCK SIX

# 6 PAYLOAD CONFIGURATION A3

| INSTRUMENT | V | S | N | Volume | Footprint | Wt | Power | Attitude | Data Rate | FOV | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SPECS | MM | MM | MM | Cubic m | Sq meters | Kg * | Watts | Know(deg) | Kbps | deg | * Wt Incl conting & antennas |
| OMIS-Optics/8 | 1321 | 635 | 610 | 0.512 | 0.839 | 89 | 230 | 0.03 | 4500 | ±55.7 xtrk | w/o sunshade |
| OMIS-Elect'r'x | 760 | 410 | 200 | 0.062 | 0.312 | 32 | 0 | 0 | 0 | 0 | 0 |
| OMIS-Ps | 300 | 200 | 200 | 0.012 | 0.060 | 11 | 0 | 0 | 0 | 0 | |
| MISS | 510 | 510 | 510 | 0.533 | 0.260 | 100 | 175 | 0.05 | 37.3 | ±70az,+56el | & 2 M Dish (.4 CM) |
| AMSU-A1 | 731 | 337 | 605 | 0.149 | 0.246 | 50 | 90 | 0.1 | 2.1 | (+50,-90) | 0 |
| MHS-Sen & Electr | 774 | 990 | 560 | 0.429 | 0.766 | 65 | 90 | 0.1 | 4.2 | (+50,-90) | |
| ITS | 600 | 400 | 400 | 0.096 | 0.240 | 40 | 75 | tbd | 1200 | tbd | 0 |
| SBUV-Sensor | 370 | 325 | 610 | 0.073 | 0.120 | 50 | 25 | 0 | 0.38 | ±6 nadir | 0 |
| SBUV-Elect | 245 | 341 | 365 | 0.030 | 0.084 | 0 | 0 | 0 | 0 | 0 | |
| SESS: | | | | | | | | | | | |
| AVM | 164 | 141 | 52 | 0.001 | 0.023 | 10 | 1 | N/A | 0.24 | in-situ | w/o Sensor Boom * |
| ABIS-UV | 250 | 560 | 330 | 0.046 | 0.140 | 8 | 7 | 0.1 | 3 | ±50 xtrk | 0 |
| RPA | 230 | 250 | 250 | 0.014 | 0.058 | 11 | 11 | 0.1 | 2 | ±60,vel vect | w/o grd plane * |
| GPS-Rcvr | 250 | 225 | 120 | 0.007 | 0.056 | 4 | 6 | 0.3 | 2 | omni | w/o antennas * |
| GPS-Process | 170 | 100 | 70 | 0.001 | 0.017 | 3 | 6 | 0 | 0 | 0 | 0 |
| DOS | 203 | 140 | 312 | 0.009 | 0.028 | 6 | 6 | N/A | 0.27 | omni | |
| NADIS | 467 | 300 | 330 | 0.046 | 0.140 | 8 | 7 | 0.1 | 1 | earth limb | 0 |
| MEPS | 222 | 146 | 152 | 0.005 | 0.032 | 4 | 5 | 0.1 | 1.2 | 8x128,zenith | 0 |
| | | | | | | | | | | | |
| S&R-RPU(2) | 195 | 365 | 280 | 0.020 | 0.071 | 31.2 | 22.8 | 0 | 0 | 0 | 0 |
| S&R-SPU | 195 | 310 | 280 | 0.017 | 0.060 | 14.4 | 6 | 0 | 0 | 0 | 0 |
| S&R-Rcvr | 458 | 458 | 152 | 0.032 | 0.210 | 15.2 | 21 | 0 | 0 | omni | w/o antennas * |
| S&R-Xmit | 350 | 370 | 115 | 0.015 | 0.130 | 15.2 | 39 | 0 | 0 | omni | w/o antennas * |
| ARGOS-RPU | 195 | 365 | 280 | 0.020 | 0.071 | 16.8 | 25.2 | 0 | 2.56 | omni | w/o antennas * |
| ARGOS-SPU(2) | 195 | 310 | 280 | 0.034 | 0.121 | 31.2 | 7.2 | 0 | 0 | 0 | 0 |
| ARGOS-DCSR | 195 | 310 | 280 | 0.017 | 0.060 | 18 | 30 | 0 | 0 | 0 | 0 |
| MSTRS-RCVR | 76 | 127 | 102 | 0.001 | 0.010 | 0 | 0 | 0 | 0 | 0 | 0 |
| MSTRS-XMT/PROC | 127 | 178 | 127 | 0.003 | 0.023 | 5 | 20 | N/A | 0 | 0 | 0 |
| MSTRS-SENSOR | 152 | 152 | 152 | 0.004 | 0.023 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | | | | | | | |
| Totals | | | | 2.188 | 4.201 | 638 | 905 | | 5756.3 | | |

PAGES 65 THROUGH 67 ARE EXEMPT FROM RELEASE AND ARE REPLACED WITH THIS PAGE.

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# 6 PAYLOAD CONFIGURATION B1, C1

| INSTRUMENT | V | S | N | Volume | Footprint | Wt | Power | Attitude | Data Rate | FOV | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SPECS | MM | MM | MM | Cubic m | Sq meters | Kg | Watts | Know(deg) | Kbps | deg | * Wt incl conting |
| | | | | | | * | | | | | & antennas |
| OMIS-Optics/8 | 1321 | 635 | 610 | 0.512 | 0.839 | 89 | 230 | 0.03 | 4●500 | ±55.7 xtrk | w/o sunshade |
| OMIS-Elect'r'x | 760 | 410 | 200 | 0.062 | 0.312 | 32 | 0 | 0 | 0 | 0 | 0 |
| OMIS-Ps | 300 | 200 | 200 | 0.012 | 0.060 | 11 | 0 | 0 | 0 | 0 | |
| MISS | 510 | 510 | 510 | 0.533 | 0.260 | 100 | 175 | 0.05 | 37.3 | ±70az,+56el | & 2 M Dish (.4 CM) |
| AMSU-A1 | 731 | 337 | 605 | 0.149 | 0.246 | 50 | 90 | 0.1 | 2.1 | (+50,-90) | 0 |
| MHS-Sen & Electr | 774 | 990 | 560 | 0.429 | 0.766 | 65 | 90 | 0.1 | 4.2 | (+50,-90) | |
| AIRS | 1397 | 775 | 762 | 0.825 | 1.083 | 165 | 265 | 0.2 | 1330 | ±55 xtrk | 0 |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| SESS: | | | | | | | | | | | |
| AVM | 164 | 141 | 52 | 0.001 | 0.023 | 10 | 1 | N/A | 0.24 | in-situ | w/o Sensor Boom * |
| ABIS-UV | 250 | 560 | 330 | 0.046 | 0.140 | 8 | 7 | 0.1 | 3 | ±50 xtrk | 0 |
| RPA | 230 | 250 | 250 | 0.014 | 0.058 | 11 | 11 | 0.1 | 2 | ±60,vel vect | w/o grd plane * |
| GPS-Rcvr | 250 | 225 | 120 | 0.007 | 0.056 | 4 | 6 | 0.3 | 2 | omni | w/o antennas * |
| GPS-Process | 170 | 100 | 70 | 0.001 | 0.017 | 3 | 6 | 0 | 0 | 0 | 0 |
| DOS | 203 | 140 | 312 | 0.009 | 0.028 | 6 | 6 | N/A | 0.27 | omni | |
| NADIS | 467 | 300 | 330 | 0.046 | 0.140 | 8 | 7 | 0.1 | 1 | earth limb | 0 |
| MEPS | 222 | 146 | 152 | 0.005 | 0.032 | 4 | 5 | 0.1 | 1.2 | 8x128,zenith | 0 |
| | | | | | | | | | | | |
| S&R-RPU(2) | 195 | 365 | 280 | 0.020 | 0.071 | 31.2 | 22.8 | 0 | 0 | 0 | 0 |
| S&R-SPU | 195 | 310 | 280 | 0.017 | 0.060 | 14.4 | 6 | 0 | 0 | 0 | 0 |
| S&R-Rcvr | 458 | 458 | 152 | 0.032 | 0.210 | 15.2 | 21 | 0 | 0 | omni | w/o antennas * |
| S&R-Xmit | 350 | 370 | 115 | 0.015 | 0.130 | 15.2 | 39 | 0 | 0 | omni | w/o antennas * |
| ARGOS-RPU | 195 | 365 | 280 | 0.020 | 0.071 | 16.8 | 25.2 | 0 | 2.56 | omni | w/o antennas * |
| ARGOS-SPU(2) | 195 | 310 | 280 | 0.034 | 0.121 | 31.2 | 7.2 | 0 | 0 | 0 | 0 |
| ARGOS-DCSR | 195 | 310 | 280 | 0.017 | 0.060 | 18 | 30 | 0 | 0 | 0 | 0 |
| MSTRS-RCVR | 76 | 127 | 102 | 0.001 | 0.010 | 0 | 0 | 0 | 0 | 0 | 0 |
| MSTRS-XMT/PROC | 127 | 178 | 127 | 0.003 | 0.023 | 5 | 20 | N/A | 0 | 0 | 0 |
| MSTRS-SENSOR | 152 | 152 | 152 | 0.004 | 0.023 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | | | | | | | |
| Totals | | | | 2.813 | 4.839 | 713 | 1070 | | 5●885.9 | | |

DMSP BLOCK SIX

# 6 PAYLOAD CONFIGURATION C3

| INSTRUMENT | V | S | N | Volume | Footprint | Wt | Power | Attitude | Data Rate | FOV | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SPECS | MM | MM | MM | Cubic m | Sq meters | Kg * | Watts | Know(deg) | Kbps | deg | * Wt incl conting & antennas |
| OMIS-Optics/8 | 1321 | 635 | 610 | 0.512 | 0.839 | 89 | 230 | 0.03 | 4 ▮500 | ±55.7 xtrk | w/o sunshade |
| OMIS-Elect'r'x | 760 | 410 | 200 | 0.062 | 0.312 | 32 | 0 | 0 | 0 | 0 | 0 |
| OMIS-Ps | 300 | 200 | 200 | 0.012 | 0.060 | 11 | 0 | 0 | 0 | 0 | |
| MISS | 510 | 510 | 510 | 0.533 | 0.260 | 100 | 175 | 0.05 | 37.3 | ±70az,+56el | & 2 M Dish (.4 CM) |
| AMSU-A1 | 731 | 337 | 605 | 0.149 | 0.246 | 50 | 90 | 0.1 | 2.1 | (+50,-90) | 0 |
| MHS-Sen & Electr | 774 | 990 | 560 | 0.429 | 0.766 | 65 | 90 | 0.1 | 4.2 | (+50,-90) | |
| AIRS | 1397 | 775 | 762 | 0.825 | 1.083 | 165 | 265 | 0.2 | 1330 | ±55 xtrk | 0 |
| SBUV-Sensor | 370 | 325 | 610 | 0.073 | 0.120 | 50 | 25 | 0 | 0.38 | ±6 nadir | 0 |
| SBUV-Elect | 245 | 341 | 365 | 0.030 | 0.084 | 0 | 0 | 0 | 0 | 0 | |
| SESS: | | | | | | | | | | | |
| AVM | 164 | 141 | 52 | 0.001 | 0.023 | 10 | 1 | N/A | 0.24 | in-situ | w/o Sensor Boom * |
| ABIS-UV | 250 | 560 | 330 | 0.046 | 0.140 | 8 | 7 | 0.1 | 3 | ±50 xtrk | 0 |
| RPA | 230 | 250 | 250 | 0.014 | 0.058 | 11 | 11 | 0.1 | 2 | ±60,vel vect | w/o grd plane * |
| GPS-Rcvr | 250 | 225 | 120 | 0.007 | 0.056 | 4 | 6 | 0.3 | 2 | omni | w/o antennas * |
| GPS-Process | 170 | 100 | 70 | 0.001 | 0.017 | 3 | 6 | 0 | 0 | 0 | 0 |
| DOS | 203 | 140 | 312 | 0.009 | 0.028 | 6 | 6 | N/A | 0.27 | omni | |
| NADIS | 467 | 300 | 330 | 0.046 | 0.140 | 8 | 7 | 0.1 | 1 | earth limb | 0 |
| MEPS | 222 | 146 | 152 | 0.005 | 0.032 | 4 | 5 | 0.1 | 1.2 | 8x128,zenith | 0 |
| | | | | | | | | | | | |
| S&R-RPU(2) | 195 | 365 | 280 | 0.020 | 0.071 | 31.2 | 22.8 | 0 | 0 | 0 | 0 |
| S&R-SPU | 195 | 310 | 280 | 0.017 | 0.060 | 14.4 | 6 | 0 | 0 | 0 | 0 |
| S&R-Rcvr | 458 | 458 | 152 | 0.032 | 0.210 | 15.2 | 21 | 0 | 0 | omni | w/o antennas * |
| S&R-Xmit | 350 | 370 | 115 | 0.015 | 0.130 | 15.2 | 39 | 0 | 0 | omni | w/o antennas * |
| ARGOS-RPU | 195 | 365 | 280 | 0.020 | 0.071 | 16.8 | 25.2 | 0 | 2.56 | omni | w/o antennas * |
| ARGOS-SPU(2) | 195 | 310 | 280 | 0.034 | 0.121 | 31.2 | 7.2 | 0 | 0 | 0 | 0 |
| ARGOS-DCSR | 195 | 310 | 280 | 0.017 | 0.060 | 18 | 30 | 0 | 0 | 0 | 0 |
| MSTRS-RCVR | 76 | 127 | 102 | 0.001 | 0.010 | 0 | 0 | 0 | 0 | 0 | 0 |
| MSTRS-XMT/PROC | 127 | 178 | 127 | 0.003 | 0.023 | 5 | 20 | N/A | 0 | 0 | 0 |
| MSTRS-SENSOR | 152 | 152 | 152 | 0.004 | 0.023 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | | | | | | | |
| Totals | | | | 2.917 | 5.043 | 763 | 1095 | | 5▮886.3 | | |

PAGES 70 THROUGH 72 ARE EXEMPT FROM RELEASE AND ARE REPLACED WITH THIS PAGE.

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# 6 S/C IMPACT SUMMARY DMSP / NOAA

- SENSOR RQMTS INCREASE OVER DMSP B/L
  - SPACE - 50% TO 130%
    - STOWED VOLUME A DRIVER
    - ALTITUDE IMPACTS
      - FOV REQUIREMENTS
      - SUN / EARTH SHADE SIZING
  - WEIGHT - 50% TO 120%
    - S/C SUPPORT FUNCTIONS IMPACTS (STRUCTURE, PROPELLANT)
    - MLV CAPABILITY
  - POWER - 70% TO 130%
    - RESIZE SOLAR ARRAY / BATTERIES
  - DATA RATE - 95% TO 140%
    - OMIS - INCREASE TO 12 BITS, DATA RATE DOUBLED
    - AIRS / ITS - HIGH DATA RATES

DMSP BLOCK SIX

# 6 S/C IMPACT SUMMARY-1 DMSP / NOAA

- **STRUCTURE:**
  - NO CHANGE TO THE BASIC BUS OR SENSOR [redacted] DESIGN
  - APPROX 35 - 60KG OF ADDITIONAL SENSOR MOUNTING HARDWARE, SUPPORT BRACKETS, ETC

- **ATTITUDE CONTROL SYSTEM**
  - NO IMPACT, WITHIN THE BASELINE CAPABILITY

- **THERMAL SYSTEM**
  - ADD PROVISIONS TO DISSIPATE APPROX 200W FOR AIRS
    - HEAT PIPES AND RADIATOR SURFACE
  - THERMAL BLANKETS, HEATERS, AND OTHER EQUIPMENT
  - ALLOCATED WEIGHT OF 10 - 20 KG

# 6 S/C IMPACT SUMMARY-2 DMSP / NOAA

- **POWER:**
  - LOAD INCREASE RANGES FROM 260W TO 582W FOR WHICH THE PRIMARY IMPACT IS THE INCREASE IN SOLAR ARRAY SIZE

| | DMSP | 'A2' | 'C3' |
|---|---|---|---|
| LOAD (W) | 1430 | 1690 | 2012 |
| SOLAR ARRAY ([redacted]W) (BOL) | 3315 | 3940 | 4716 |
| SOLAR ARRAY AREA (SQ FT-SI) | 276 | 329 | 393 |
| SOLAR ARRAY LENGTH (FSAT) | | | |
| • SILICON CELLS (FT) | 41 | 49 | 58* |
| • GaAs CELLS (FT) | 29 | 34 | 41 |

* FSAT MAX LENGTH = 66 FT

  - BATTERIES - NO IMPACT, WITHIN THE CAPABILITY OF THE BASELINE THREE 90 A-H NIH2 BATTERIES
  - ELECTRICAL HARNESSING FOR ADDED SENSORS = 10 - 20 KG

# S/C IMPACT SUMMARY-3
# DMSP / NOAA

6

- **PROPULSION SYSTEM**
  - FUNCTION OF ORBIT ADJUST & CONTINGENCY REQUIREMENTS OF CONVERGED SYSTEM: (estimated Delta Velocity)

| ORBIT ADJUST PLUS CONTINGENCY SCENARIOS: | TOTALS |
|---|---|
| DMSP - 100% COVERAGE | 38 m/s |
| NOAA - ASCENDING NODE & ALTITUDE | 10 m/s |
| EOS - REPEAT GROUND TRACK | 90 m/s |
| DEBOOST - NO PROVISION (>> ON-ORBIT RQMT) | 0 |

  - FOR DELTA V = 40 M/S, ADD 8 - 15 KG OF PROPELLANT
    - TOTAL PROPELLANT = 51 TO 58 KG
    - FSAT HAS A 68 KG OR A 500 KG TANK CAPABILITY
  - PROPULSION SYSTEM - NO IMPACT

# 6 S/C IMPACT SUMMARY-4 DMSP / NOAA

## HYDRAZINE VS COLD GAS STUDY

- DEFINE ISSUE
  - CONTAMINATION - DEFINE SENSORS AND OBSCURATION LIMITS (REQUIREMENTS)
- PERFOMANCE
  - COMPARE HYDRAZINE VS GASEOUS NITROGEN
    - Isp, WEIGHT, COMPONENTS, CONTAMINATION
  - TANK SIZE IMPACTS
  - THRUSTER LOCATION AND PLUME DIRECTION
  - EXHAUST PLUME ANALYSIS RELATIVE TO SENSOR LOCATIONS
- IMPACT TO BASELINE BUS DESIGN (N2H4)

# 6 S/C IMPACT SUMMARY-5 DMSP / NOAA

- **ON-BOARD PROCESSING SUBSYSTEM**
  - INCREASES ON-BOARD SOLID-STATE MEMORY FROM 10 GBITS (EOL) TO 55 GBITS (EOL)
  - INCREASES MISSION DATA PROCESSING REQUIREMENTS FROM 30 MIPS (DATA MERGING - 15 MIPS; COMPRESSION - 15 MIPS) TO 83 MIPS (DATA MERGING - 68 MIPS; COMPRESSION - 15 MIPS)

- **COMMAND, CONTROL AND TELEMETRY SUBSYSTEM**
  - REPLACES THE TWO S-BAND STORED DATA DOWNLINKS AT 10 MBPS WITH SINGLE X-BAND DOWNLINK AT 75 MBPS
  - ADDS NOAA HRPT DOWNLINK AT 1700 MHZ
  - ADDS NOAA LPRT DOWNLINK AT 137 MHZ
  - ELIMINATES THE S-BAND STORE & FORWARD DOWNLINK

# S/C IMPACT SUMMARY-6
# DMSP / NOAA

6

- **WEIGHT (KG):**
  - ADDITIONAL S/C WEIGHT ALLOCATION

| CONFIGURATION (MIN/MAX) | 'A2' | 'C3' |
|---|---|---|
| • SOLAR ARRAY | 14 | 32 |
| • PROPELLANT | 8 | 15 |
| • C & DH | 38 | 45 |
| • STRUCTURE | 35 | 60 |
| • THERMAL | 10 | 20 |
| • ELECTRICAL HARNESSES | 10 | 20 |
| TOTAL | 115 | 192 |
| • SENSOR DELTA (REF) | 210 | 411 |
| • TOTAL SATELLITE WEIGHT | 2059 | 2336 |
| • DELTA II (7920) 85% RATED | 2700 | 2700 |
| • MARGIN (KG) | 641 | 364 |

DMSP BLOCK SIX

# PAYLOAD CONFIGURATION B3

6

| INSTRUMENT | V | S | N | Volume | Footprint | Wt | Power | Attitude | Data Rate | FOV | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SPECS | MM | MM | MM | Cubic m | Sq meters | Kg * | Watts | Know(deg) | Kbps | deg | * Wt incl conting & antennas |
| OMIS-Optics/8 | 1321 | 635 | 610 | 0.512 | 0.839 | 89 | 230 | 0.03 | 40500 | ±55.7 xtrk | w/o sunshade |
| OMIS-Elect'r'x | 760 | 410 | 200 | 0.062 | 0.312 | 32 | 0 | 0 | 0 | 0 | 0 |
| OMIS-Ps | 300 | 200 | 200 | 0.012 | 0.060 | 11 | 0 | 0 | 0 | 0 | |
| MISS | 510 | 510 | 510 | 0.533 | 0.260 | 100 | 175 | 0.05 | 37.3 | ±70az,+56el | & 2 M Dish (.4 CM) |
| AMSU-A1 | 731 | 337 | 605 | 0.149 | 0.246 | 50 | 90 | 0.1 | 2.1 | (+50,-90) | 0 |
| MHS-Sen & Electr | 774 | 990 | 560 | 0.429 | 0.766 | 65 | 90 | 0.1 | 4.2 | (+50,-90) | |
| AIRS | 1397 | 775 | 762 | 0.825 | 1.083 | 165 | 265 | 0.2 | 1330 | ±55 xtrk | 0 |
| SBUV-Sensor | 370 | 325 | 610 | 0.073 | 0.120 | 50 | 25 | 0 | 0.38 | ±6 nadir | 0 |
| SBUV-Elect | 245 | 341 | 365 | 0.030 | 0.084 | 0 | 0 | 0 | 0 | 0 | |
| SESS: | | | | | | | | | | | |
| AVM | 164 | 141 | 52 | 0.001 | 0.023 | 10 | 1 | N/A | 0.24 | in-situ | w/o Sensor Boom * |
| ABIS-UV | 250 | 560 | 330 | 0.046 | 0.140 | 8 | 7 | 0.1 | 3 | ±50 xtrk | 0 |
| RPA | 230 | 250 | 250 | 0.014 | 0.058 | 11 | 11 | 0.1 | 2 | ±60,vel vect | w/o grd plane * |
| GPS-Rcvr | 250 | 225 | 120 | 0.007 | 0.056 | 4 | 6 | 0.3 | 2 | omni | w/o antennas * |
| GPS-Process | 170 | 100 | 70 | 0.001 | 0.017 | 3 | 6 | 0 | 0 | 0 | 0 |
| DOS | 203 | 140 | 312 | 0.009 | 0.028 | 6 | 6 | N/A | 0.27 | omni | |
| NADIS | 467 | 300 | 330 | 0.046 | 0.140 | 8 | 7 | 0.1 | 1 | earth limb | 0 |
| MEPS | 222 | 146 | 152 | 0.005 | 0.032 | 4 | 5 | 0.1 | 1.2 | 8x128,zenith | 0 |
| | | | | | | | | | | | |
| S&R-RPU(2) | 195 | 365 | 280 | 0.020 | 0.071 | 31.2 | 22.8 | 0 | 0 | 0 | 0 |
| S&R-SPU | 195 | 310 | 280 | 0.017 | 0.060 | 14.4 | 6 | 0 | 0 | 0 | 0 |
| S&R-Rcvr | 458 | 458 | 152 | 0.032 | 0.210 | 15.2 | 21 | 0 | 0 | omni | w/o antennas * |
| S&R-Xmit | 350 | 370 | 115 | 0.015 | 0.130 | 15.2 | 39 | 0 | 0 | omni | w/o antennas * |
| ARGOS-RPU | 195 | 365 | 280 | 0.020 | 0.071 | 16.8 | 25.2 | 0 | 2.56 | omni | w/o antennas * |
| ARGOS-SPU(2) | 195 | 310 | 280 | 0.034 | 0.121 | 31.2 | 7.2 | 0 | 0 | 0 | 0 |
| ARGOS-DCSR | 195 | 310 | 280 | 0.017 | 0.060 | 18 | 30 | 0 | 0 | 0 | 0 |
| MSTRS-RCVR | 76 | 127 | 102 | 0.001 | 0.010 | 0 | 0 | 0 | 0 | 0 | 0 |
| MSTRS-XMT/PROC | 127 | 178 | 127 | 0.003 | 0.023 | 5 | 20 | N/A | 0 | 0 | 0 |
| MSTRS-SENSOR | 152 | 152 | 152 | 0.004 | 0.023 | 0 | 0 | 0 | 0 | 0 | 0 |
| MODIS | 970 | 1590 | 990 | 1.527 | 1.542 | 238 | 225 | 0.03 | 6500 | ±58 xtrk | Data Rate 11M sun |
| CERES | 590 | 570 | 700 | 0.235 | 0.336 | 45 | 50 | 0.03 | 10 | ±84 cone, +Z | 0 |
| | | | | | | | | | 2 | | |
| Totals | | | | 4.679 | 6.922 | 1046 | 1370 | | 16396 | | |

# 6 B3 S/C LAYOUT SUMMARY

- CONFIGURATION B3 - ACCOMMODATED IN 14' SHROUD ON ATLAS II CLASS MLV

- PAYLOAD MANIFEST
  - 5 LARGE SENSORS (0.4 TO 1.5 CuM Ea)
    - OMIS, MISS, AMSU-A, AIRS, MODIS = 3.84 CuM (83%)
  - 13 SMALL SENSORS (< 0.25 CuM Ea)
  - TOTAL SENSOR VOLUME - 4.62 CuM (DMSP B/L +270%)

PAGES 82 THROUGH 84 ARE EXEMPT FROM RELEASE AND ARE REPLACED WITH THIS PAGE.

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# 6 S/C IMPACT SUMMARY - B3 DMSP / NOAA / EOS

- **SENSOR GROWTH DRIVERS (> DMSP B/L)**
  - SPACE + 270%
  - WEIGHT + 200%
  - POWER + 190%
  - DATA + 370%
- **SENSOR PLATFORM**
  - SEVERAL LARGE SENSORS - FAVORS A MONOCOQUE BUS
  - WINGED BUS - MORE DIFFICULT, UNDER STUDY
- **SPACECRAFT EQUIPMENT (@ 833 KM)**
  - OBP & DATA STORAGE - SIGNIFICANT INCREASE IN SIZE (OPB - 125 MIPS, SSM - 100 GB)
  - DATA DOWNLINKS - 2X BANDWIDTH, EQUIPMENT GROWTH DEPENDENT ON SOLUTION

# 6 S/C IMPACT SUMMARY - B3 DMSP / NOAA / EOS

- **POWER**
  - BUS = 1114, SENSORS = 1361; TOTAL LOAD = 2410 W
  - SOLAR ARRAY = 5677 W (BOL); WT = +54 KG
    - SIZE (Sq Ft): 473 (Si), 334 (GaAs)
  - BATTERIES: 161 A-H's (< 35% DOD)
    - ADD 4th 90 A-H BATTERY WORST CASE (+50Kg) (ASSUMES RECONDITIONING REQUIRED)
- **WEIGHT (KG)**

| | | |
|---|---|---|
| • BUS - DMSP B/L | | 1390 |
| • SENSORS | | 1078 |
| • S/C IMPACT (EOS BUS, SA, BATT, OBP, COMM) | | 760 |
| • SATELLITE TOTAL | | 3228 |
| • ATLAS IIAS (85% RATED) | | 4400 |
| • EOS B/L SATELLITE (WITH MIMR) | ~ | 3100 |

# 6 INTER-PAYLOAD ISSUES

- PHYSICAL CHARACTERISTICS - SIZE
  - MIMR @ 3.5 CuM; MODIS @ 2.4 CuM; AIRS, MISS, MHS, OMIS @ 0.5 - 0.8 CuM
- FIELD-OF-VIEW'S (FOV)
  - CERES - NEARLY +Z HEMISPHERE (LIMITS SOLAR ARRAY TRACKING)
  - OMIS, AIRS, MODIS - RADIATORS, COLD SPACE CLEAR VIEW
  - SESS - MULTI FOV'S TO ZENTIH, LIMB, VEL VECTOR, AVM ISOLATION, GPS MULTI-PATH FREE, ETC.
  - MISS CONICAL SCANNER (140 DEG)
- STABILITY
  - POINTING AND/OR MAPPING RQMTS AFFECTED BY SENSOR DISTURBANCES (SCANNING DEVICES)
  - MODIS 28 A-S/SEC SENSITIVITY
  - MIMR - MAJOR DISTURBANCE SOURCE
- CO-ALIGNMENT
  - AIRS TO AMSU-A & MHS (0.3 DEG)

DMSP BLOCK SIX

# 6 PAYLOAD ACCOMMODATION STUDY TASKS TIM'S 2, 3, & 4

- **SENSORS**
  - GROUPINGS, EDR'S, CONSTELLATION
  - COLLECTION, COMPRESSION, STORAGE, FORMATTING
  - DATA DOWNLINKING, ROUTING, QUALITY
- **ALTITUDE**
  - SENSOR IMPACTS (RESOLUTION, SNR, SIZING)
  - EARTH COVERAGE VS USAGE
  - COMMUNICATION COVERAGE, TIMELINESS
- **DESIGN LIFE - 7 YEARS**
  - SENSOR DESIGN LIFE, RELIABILITY NUMBERS
  - SATELLITE SYSTEM AVAILABILITY/RELIABILITY

6

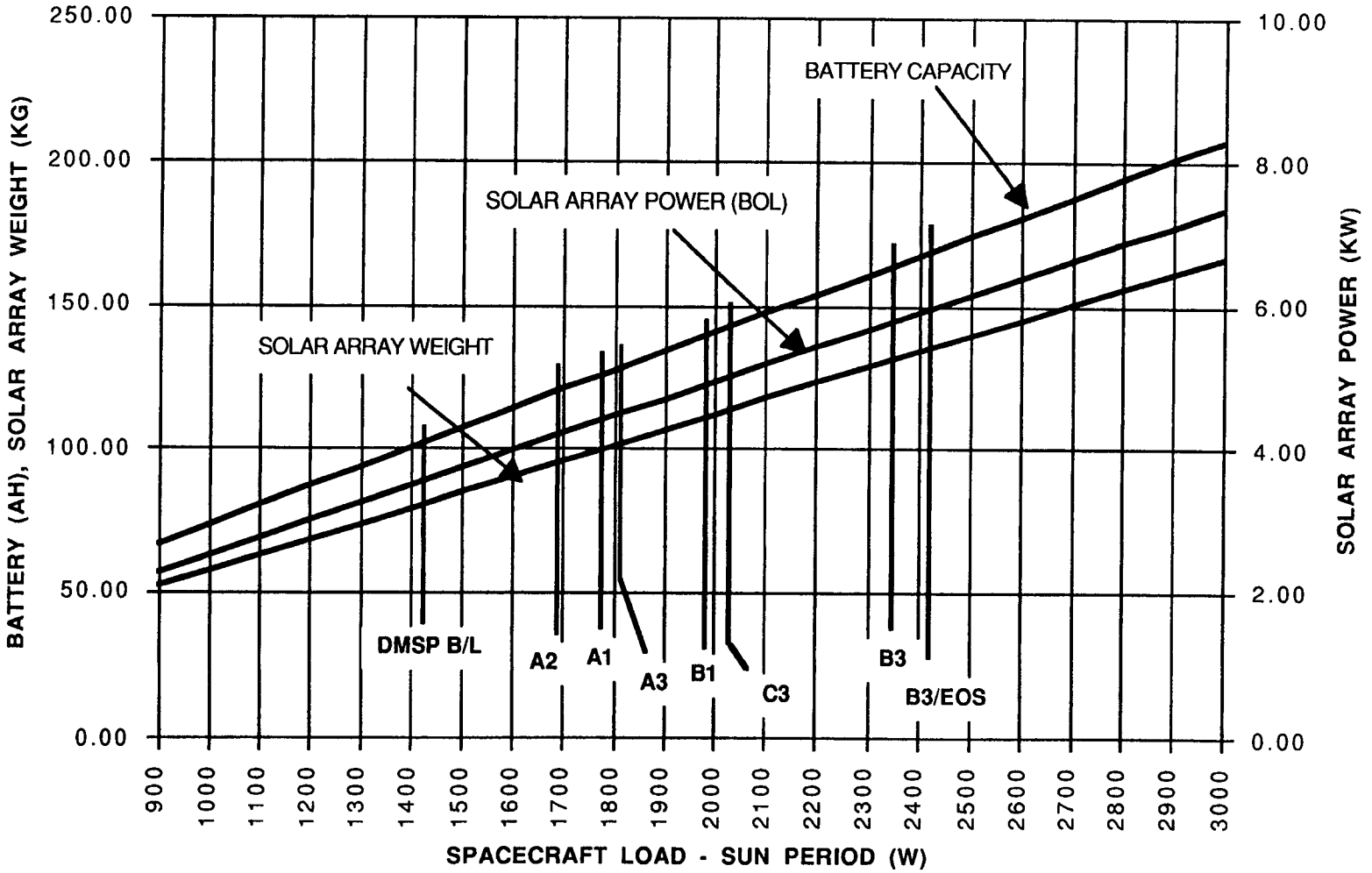
# TECHNICAL DATA

# ADDENDUM

# 6

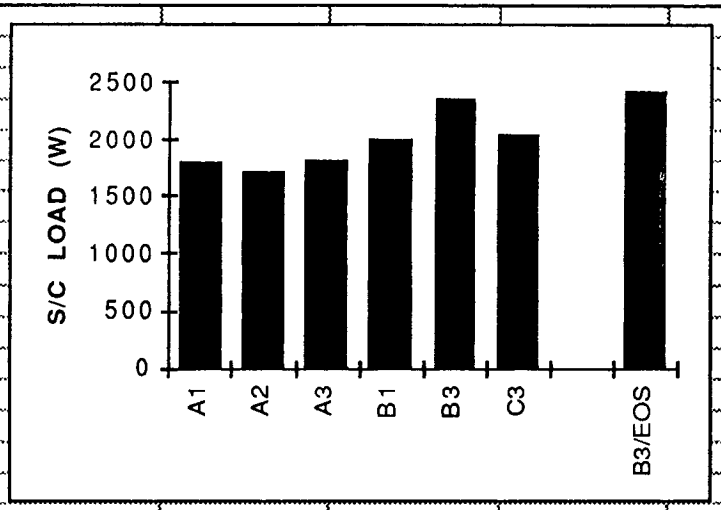
# POWER SYSTEM

# 6 POWER SIZING VS S/C LOAD



# 6 POWER IMPACTS

| SUBSYSTEM | POWER (W) DMSP | POWER (W) EOS |
|---|---|---|
| STRUCTURES | | 51 |
| ELECTRICAL | 56 | 120 |
| ATTITUDE DETERM & CTR | 213 | 198 |
| CMD, TLM, DH | 298 | 373 |
| PROPULSION | 3 | 33 |
| THERMAL | 195 | 73 |
| SUB-TOTAL | 765 | |
| SURVIVABILITY | 18 | |
| TOTAL S/C BUS | 783 | 848 |




| SENSOR COMPLEMENT | SENSOR TOTAL W | GROWTH (W) B/L +25% CONV +0% | S/C DELTA W (15%) Comm +75 | TOTAL SATELLITE LOAD W | Solar Array (BOL) W | SA WT-Diff KG (44w/kg) | BATTERY A-H Total DOD<35% | BATTERY Wt Diff (KG) |
|---|---|---|---|---|---|---|---|---|
| DMSP BASELINE | 476 | 119 | 0 | 1378 | 3315 | 0 | 92 | 0 |
| NOAA B/L | 582 | 146 | 91 | 1601 | 3853 | 12.2 | 107 | 0 |
| CONFIGURATION | | | | | | | | |
| A1 | 880 | 0 | 136 | 1799 | 4329 | 23.0 | 120 | 0 |
| A2 | 805 | 0 | 124 | 1712 | 4121 | 18.3 | 114 | 0 |
| A3 | 905 | 0 | 139 | 1827 | 4398 | 24.6 | 122 | 0 |
| B1 | 1070 | 0 | 164 | 2017 | 4855 | 35.0 | 134 | 0 |
| B3 | 1370 | 0 | 209 | 2362 | 5687 | 53.9 | 157 | 0 |
| C3 | 1095 | 0 | 168 | 2046 | 4925 | 36.6 | 136 | 0 |
| B3/EOS | 1370 | 0 | 274 | 2427 | 5843 | 57.5 | 162 | 50 ** |
| (EOS BUS @ 945W) | | | | | | ** ADD 1 BATTERY (90 AH), IF REQUIRED | | |

6

# OBP / COMMAND, CONTROL, AND TELEMETRY

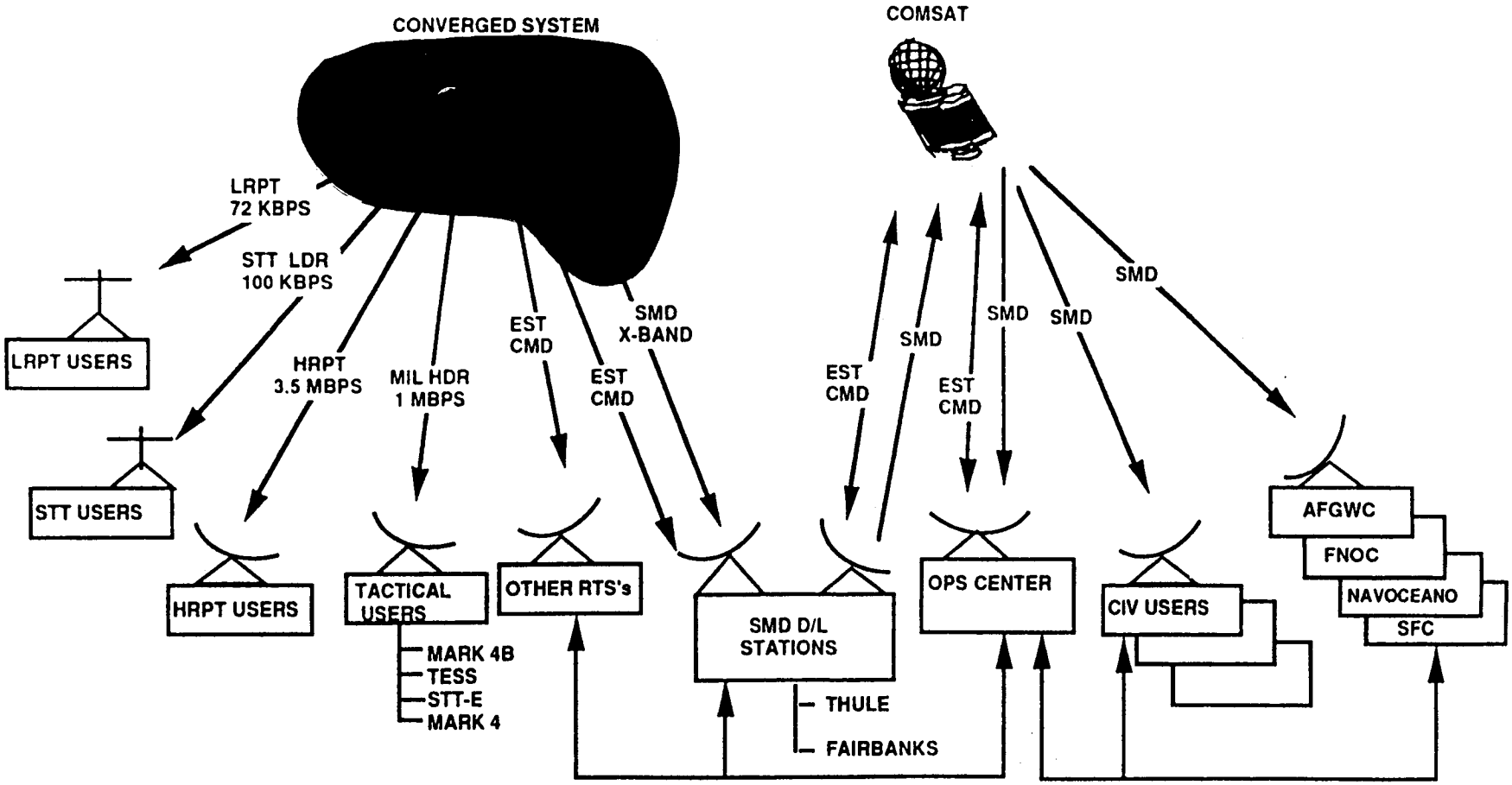
- DRIVERS:
  - DATA RATES - OMIS, MODIS, AIRS, ITS
  - DATA STORAGE - NON COMPRESSED DATA
  - FORMATTING (DMSP, CCSDS)
  - DOWNLINKS - DMSP, NOAA, & NASA
    - CENTRAL SITES, RTT, HRPT, LRPT
  - ENCRYPTION, CLEAR
  - TRACKING ANTENNA - RFI CONFLICT (STUDY)

# 6 ASSUMPTIONS

- THE ON-ORBIT STORAGE REQUIREMENT IS FOR 1.25 ORBITS
- ORBIT PERIOD BASED ON AN ALTITUDE OF 833 KM
- ALL SENSOR DATA RECORDS ARE STORED UNCOMPRESSED
- STORED MISSION DATA IS DOWNLINKED UNCOMPRESSED
- REAL-TIME LINKS WILL BE PROVIDED IN POES AND DMSP FORMATS
- STORE AND FORWARD IS NOT TO INCLUDED
- 25 % PAYLOAD GROWTH IS NOT A REQUIREMENT

DMSP BLOCK SIX

# 6 CONVERGED SYSTEM -- MISSION DATA ROUTING



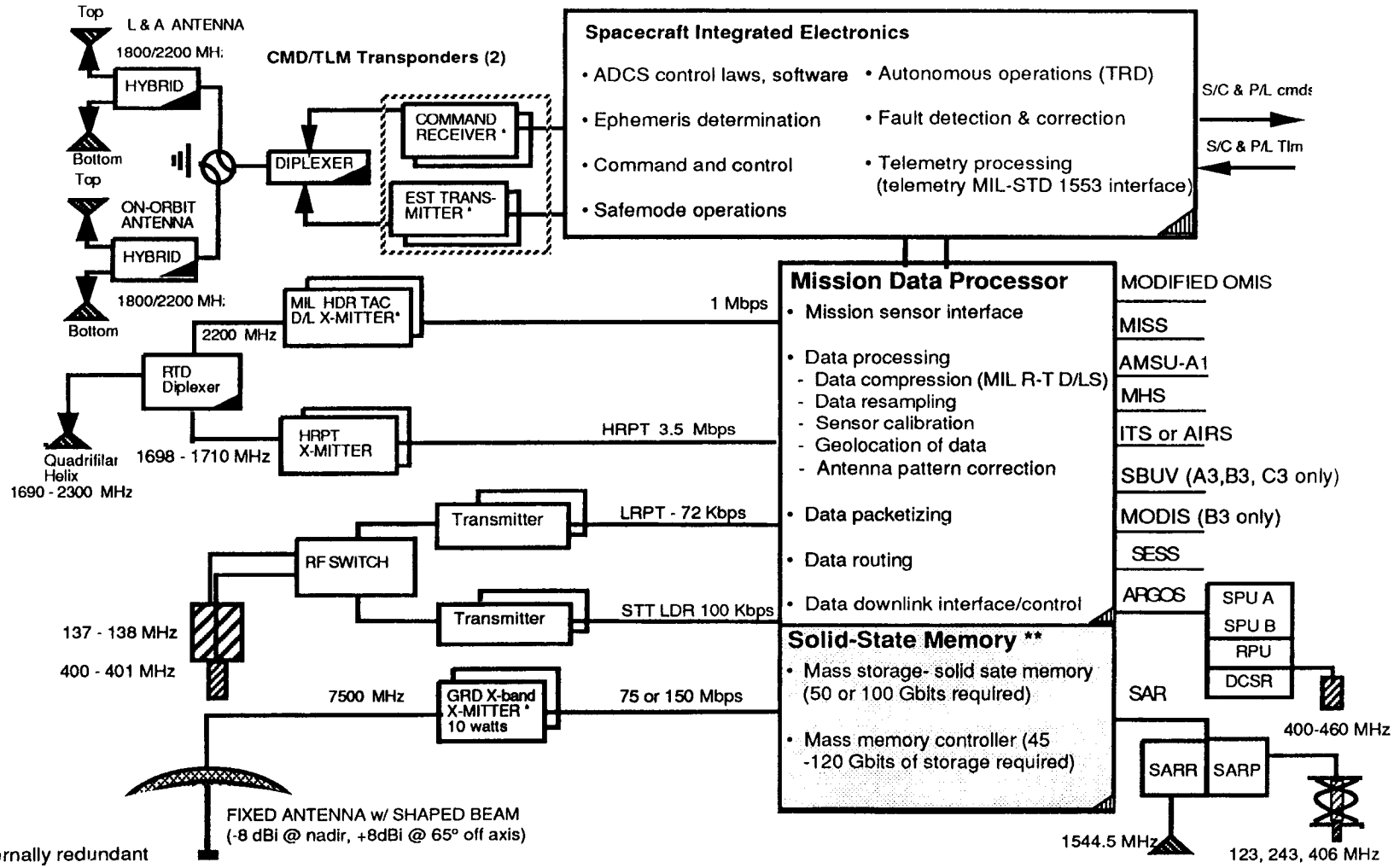
DMSP BLOCK SIX

# 6 ON-BOARD STORAGE, PROCESSING & X-BAND DOWNLINK REQUIREMENTS

| | BLOCK 6 | CONVERGED ALL EXCEPT B3 | CONVERGED B3 |
|---|---|---|---|
| STORED MISSION DATA STORAGE | 10 GBITS | 36 - 46 GBITS<br>SELECTED 50 GBITS | 98 GBITS<br>SELECTED 100 GBITS |
| MISSION DATA PROCESSING* | 30 MIPS | 83 MIPS | 110 MIPS |
| COMPRESSION | 15 MIPS | 15 MIPS | 15 MIPS |
| DATA MERGING | 15 MIPS | 68 MIPS | 15 MIPS |
| X-BAND DOWNLINK | 10 MBPS | 54 - 70 MBPS<br>SELECTED 75 MBPS | 149 MBPS<br>SELECTED 150 MBPS |

* IMPLEMENTED IN SOFTWARE ON GENERAL PURPOSE PROCESSORS

# 6 CONVERGED OBP AND CCT SUBSYSTEMS



# 6

# PROPULSION

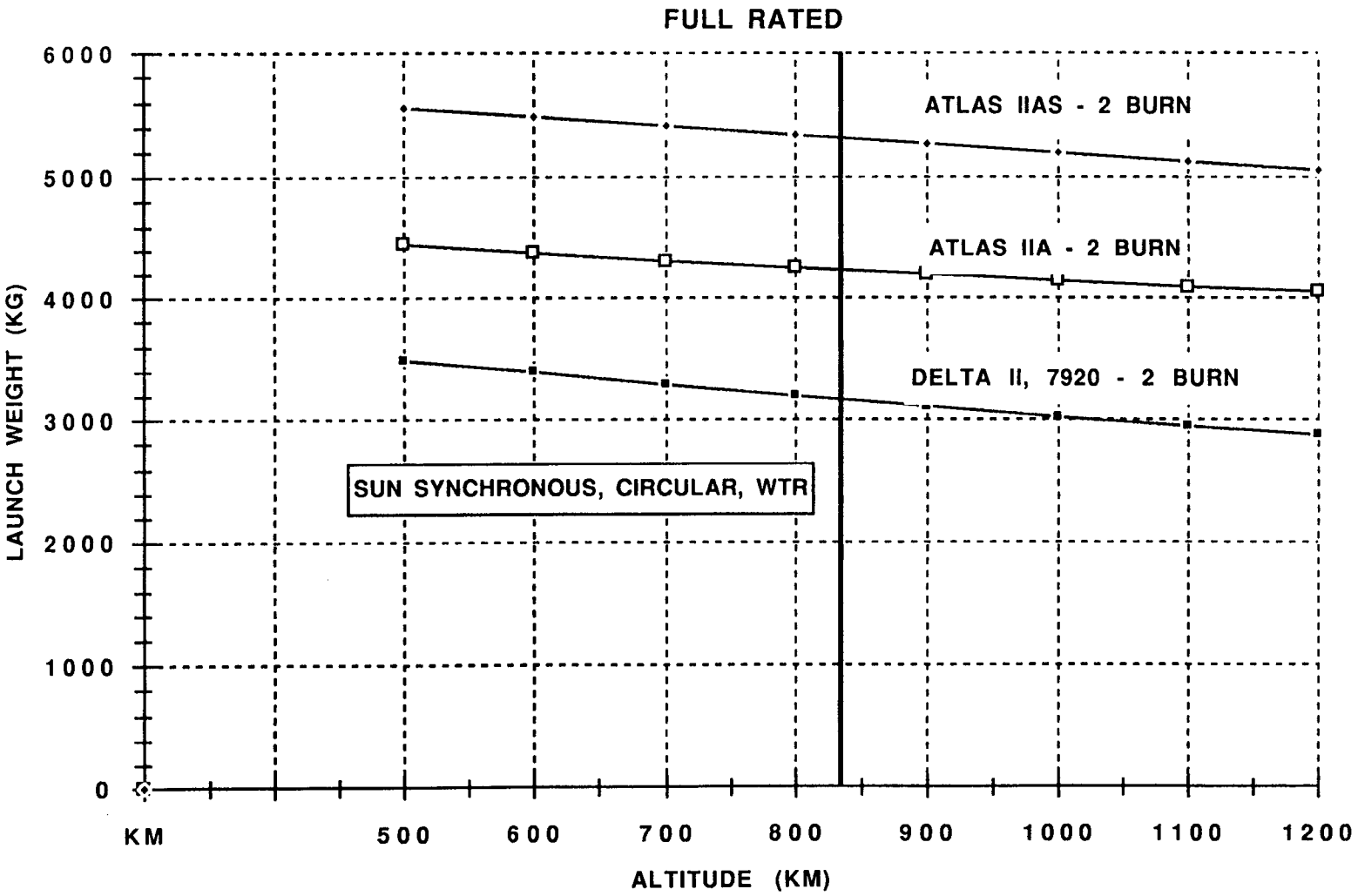
DMSP BLOCK SIX

# 6 PROPELLANT SIZING

| | | DMSP B/L | | NOAA B/L | | EOS B/L | |
|---|---|---|---|---|---|---|---|
| S/C MASS (KG) | | 1800 | | 2400 | | 3000 | |
| ALTITUDE (KM) | | 833 | | 824 | | 705 | |
| LIFE (YRS) | | 7 | | 5 | | 7 | |
| ORBIT MAINT RQMT | | | | | | | |
| COVERAGE | | 100% | | | | | |
| ASC NODE | | | | ± 10 MIN | | | |
| REPEATING GRD TRK | | | | | | ± 1 KM | |
| ALTITUDE | | | | ±19 KM | | | |
| PROP BUDGET | | DELTA V m/s | PROP WT kg N2H4 | DELTA V m/s | PROP WT kg GN2 | DELTA V m/s | PROP WT kg N2H4 |
| INJECTION CORRECTION | | 10 | 11 | 4 | 19 | 20 | 37 |
| SAFEMODE/ATTITUDE CTRL | | 23 | 26 | tbd | | 10 | 19 |
| ORBIT MAINT | | 5 | 6 | 6 | 29 | 60 | 110 |
| TOTALS | m/s, kg | 38 | 43 | 10 | 48 | 90 | 166 |
| CONVERGENCE CONFIG'S | DMSP B/L | A1 | A2 | A3 | B1 | B3 | C3 |
| S/C MASS (KG) | 1828 | 2103 | 2048 | 2172 | 2276 | 2735 | 2346 |
| DELTA V ESTIMATE (m/s) | 38 | 40 | 40 | 40 | 40 | 40 | 40 |
| PROPELLANT (KG) | 43 | 52 | 51 | 54 | 56 | 68 | 58 |
| PROP WT DELTA (KG) | 0 | 9 | 8 | 11 | 13 | 25 | 15 |

# 6

# SPACECRAFT WEIGHT

DMSP BLOCK SIX

# 6 LAUNCH CAPABILITY